14

FOURTH QUARTERLY PROGRESS REPORT

PRODUCTION ENGINEERING MEASURE (PEM)

MANUFACTURING METHODS AND TECHNIQUES FOR PIEZOELECTRIC TRANSFORMERS

CONTRACT DAAB07-76-C-0008

April 14, 1976 to July 14, 1976

PLACED BY:

PRODUCTION DIVISION, PROCUREMENT AND
PRODUCTION DIRECTORATE, USAECOM
FORT MONMOUTH, NEW JERSEY

CONTRACTOR
HONEYWELL INC.
GOVERNMENT AND AERONAUTICAL PRODUCTS DIVISION
CERAMICS CENTER
GOLDEN VALLEY, MINNESOTA

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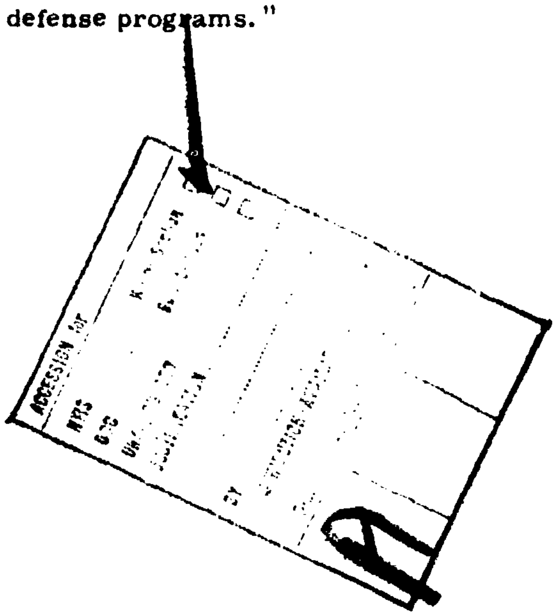

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The Fourth Quarterly Report for Contract DAAB07-76-C-0008 describes the progress and status of this program to establish a cost-effective production capability for 18mm and 25mm piezoelectric ceramic transformers. The construction and test results from engineering samples is reviewed. The life test station and results on the first and second engineering samples is also presented.

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FOURTH QUARTERLY REPORT

CONTRACT NO. DAAB07-76-C-0008
Manufacturing Methods and Techniques for Piezoelectric Transformers

PERIOD COVERED: April 14, 1976 to July 14, 1976

PREPARED BY: W. Harrison
L. Hiltner
W. Kammeyer

OBJECT OF STUDY:

The objective of this contract is to establish a production capability for 18mm and 25mm piezoelectric ceramic transformers with all required manufacturing methods, test procedures and production tooling for high production rates. These transformers are to be used in conjunction with a power supply for operating night vision image intensifier tubes.

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ABSTRACT

The fourth Quarterly Report for Contract DAAB07-76-C-0008 describes the progress and status of this program to establish a cost-effective production capability for 18mm and 25mm piezoelectric ceramic transformers. The construction and test results from engineering samples are reviewed. The life test station and results on the first and second engineering samples are also presented.

PURPOSE

This Production Engineering Measure (PEM) contract covers all of the tooling, test methods, package designs, mounting techniques, interconnection techniques and other manufacturing methods and techniques required for eventual production of 18mm and 25mm piezoelectric transformers. These units are to be used with a power supply to improve the performance and reduce cost for image intensifier tubes used in various night vision devices.

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SECTION I
APPROACH

Our approach to both the 18mm and 25mm PET designs, its advantages and the analytical method used to determine performance of these transformers was discussed in the first quarterly report[1].

(1) First Quarterly Progress Report, Production Engineering Measures (PEM), Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, July 14, 1975 to October 14, 1975.

SECTION II
PROCESS REVIEW

This section updates the status of each process step planned for manufacturing both the 18mm and 25mm PETs. Since there are only minor differences between the 18mm and 25mm process, one process outline will suffice. The new materials and special tooling that have been purchased, designed or built — and not discussed in previous quarterly reports — are discussed below.

A. RAW MATERIALS

The standard operating procedure for processing raw materials, calculating batch compositions and compounding each batch was fully described in the first quarterly report.[1]

B. COMPLETED PROCESSES

This section will describe or update those manufacturing procedures that have been completed thus far in the first four quarters of this program. Each operation given has been previously[2, 3] identified with a number, description and a list of the materials, tools, fixtures and procedures required to complete this operation. Only those operations that have been revised or not previously described are discussed. Figure 1 is an update of the process flow that identifies each operation. Appendix A contains a detailed parts list and drawings for the 18mm and 25mm PETs.

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(2) Second Quarterly Progress Report, Production Engineering Measure (PEM) Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, October 14, 1975 to January 14, 1976.

(3) Third Quarterly Progress Report, Production Engineering Measure (PEM) Manufacturing Methods and Techniques for Piezoelectric Transformers, Contract Number DAAB07-76-C-0008, January 14, 1976 to April 14, 1976.

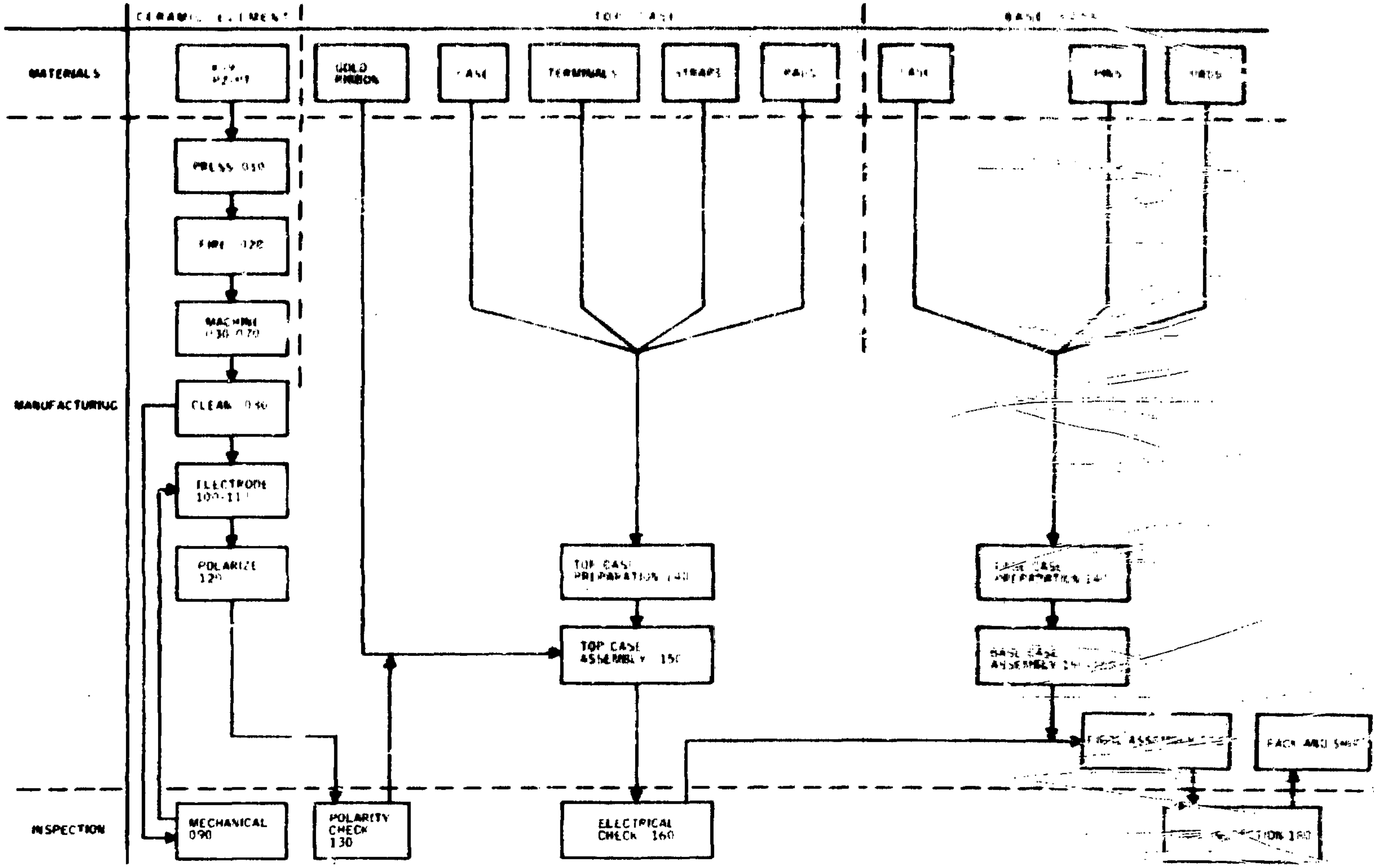


Figure 1. 18mm and 25mm Packaged PET Flow Diagram

Manufacturing Procedure for 18mm and 25mm Packaged PETs

OP 010 Slug Processing (no change)

OP 020 Hot Press Slugs (no change)

OP 030 Blanchard Grind Slugs (top and bottom) (no change)

OP 040 Core Drill Slugs (no change)

OP 050 Hone I. D. of Slugs (add tolerance)

B. 2 1. 040 ± 0. 001 inch I. D. for 18mm
1. 700 ± 0. 001 inch I. D. for 25mm

OP 060 Grind O. D. of Slugs

B. 3 Correct Diameter to 1. 475

OP 065 Slice 25mm Half Torroids (no change)

OP 070 Mount and Slice Slugs (no change)

OP 080 Clean Elements (no change)

OP 090 Inspection of Unelectroded 18 and 25mm Elements (revised)

Inspect sample for mechanical size per Dwg. No. 28100576 or 28100571 respectively.

OP 100 Apply Silver Electrodes (no change)

OP 110 Silver Fire (no change)

OP 120 Polarization (no change)

OP 130 Check Polarity (formerly OP 125)

(Deleted former OP 130 and made a part of OP 150)

OP 140 PET Package Preparation 18mm (revisions)

A1. Package Case Top - Dwg. 28100580

A2. Package Case Top - Dwg. 28100581

A3. Terminals - Dwg. 28100572

old A5. Deleted

new A5. 18mm Shorting Straps Top - Dwg. 38100579

new A6. 18mm Pins - Dwg. 28100570-002

new A7. Same as old A8

new A8. Same as old A9

C9. (to read) Ultrasonic clean package case base in freon

C10. Delete

C11. Delete

OP 140 PET Package Preparation 25mm (revisions)

A1. Package Case, Top - Dwg. 28100574

A2. Package Case, Base - Dwg. 28100575

A3. Terminals - Dwg. 28100572

A5. (to read) P_ Terminal Pin - Dwg. 28100570-003

A6. 25mm Shorting Straps, Top - Dwg. 28100573

A7. 25mm Pins - Dwg. 28100570-001

C9. (to read) Ultrasonic Clean package case base in freon

C10. Delete

C11. Delete

OP 150 Top Case Element Assembly (revised)

A. Materials

1. Conductive epoxy
2. Nonconductive epoxy
3. Solder
4. Gold Wire

B. Tools and Fixtures

1. Solder Iron
2. Curing Oven
3. Tweezers
4. Snips

C. Procedure

1. Solder gold wire to + terminal of first PET element, Dwg. 28100576 or 28100571.

2. Solder end of gold wire to each P_-, V_{12} and V_3 shorting strap and insert wire through 0. 002 inch hole of top case, Dwg. 28100577 or 28100569, as in Dwg. 28100560 or 28100561.

3. Fold each wire into proper place (P_-, V_{12} and V_3) per 28100560 or 28100561 and attach with conductive epoxy.

4. Add non-conductive epoxy and next element.

5. Cure in oven.

6. Fold in place P_+ wires and attach with conductive epoxy per Dwg. 28100560 or 28100561. This completes 18mm assembly. For 25mm assembly add non-conductive epoxy and next element.

7. Cure in oven.

8. For 25mm repeat 3 through 7 as required to complete assembly Dwg. 28100561.

OP 160 Process Control Electrical Check (title change)

B2. (to read) From test console record resonant frequency, input voltage, input current and output voltages on data sheet and check against the room temperature requirements on Dwg. 28100560 or 28100561.

OP 170 Final Package Assembly (Revisions)

A2. (to read) solder iron

B1. (to read) Select a top case, Dwg. 28100577 or 28100567, and a base case (Dwg. 28100578 or 28100568); then align shorting pins from base case with holes in top case.

B2. Same as previous B-3.

B3. After all pins have been inserted in the package and it is fully closed, snip off excess pin length and solder to shorting strap.

B4. Same as previous B-7.

OP 180 Final Inspection (Revisions)

Inspect packaged 18 or 25mm piezoelectric transformers per Dwg. 28100560 or 28100561, respectively.

SECTION III
STATUS AND FUTURE WORK

This section describes the status of work against the various tasks outlined in Figure 2 which were active during this fourth quarter of the program.

A. TASK 1-6

Work completed previously.

B. TASK 7 - POLARIZATION TOOLING

Work on the polarization tooling has been delayed until next quarter.

C. TASK 8 - TEST CONSOLE

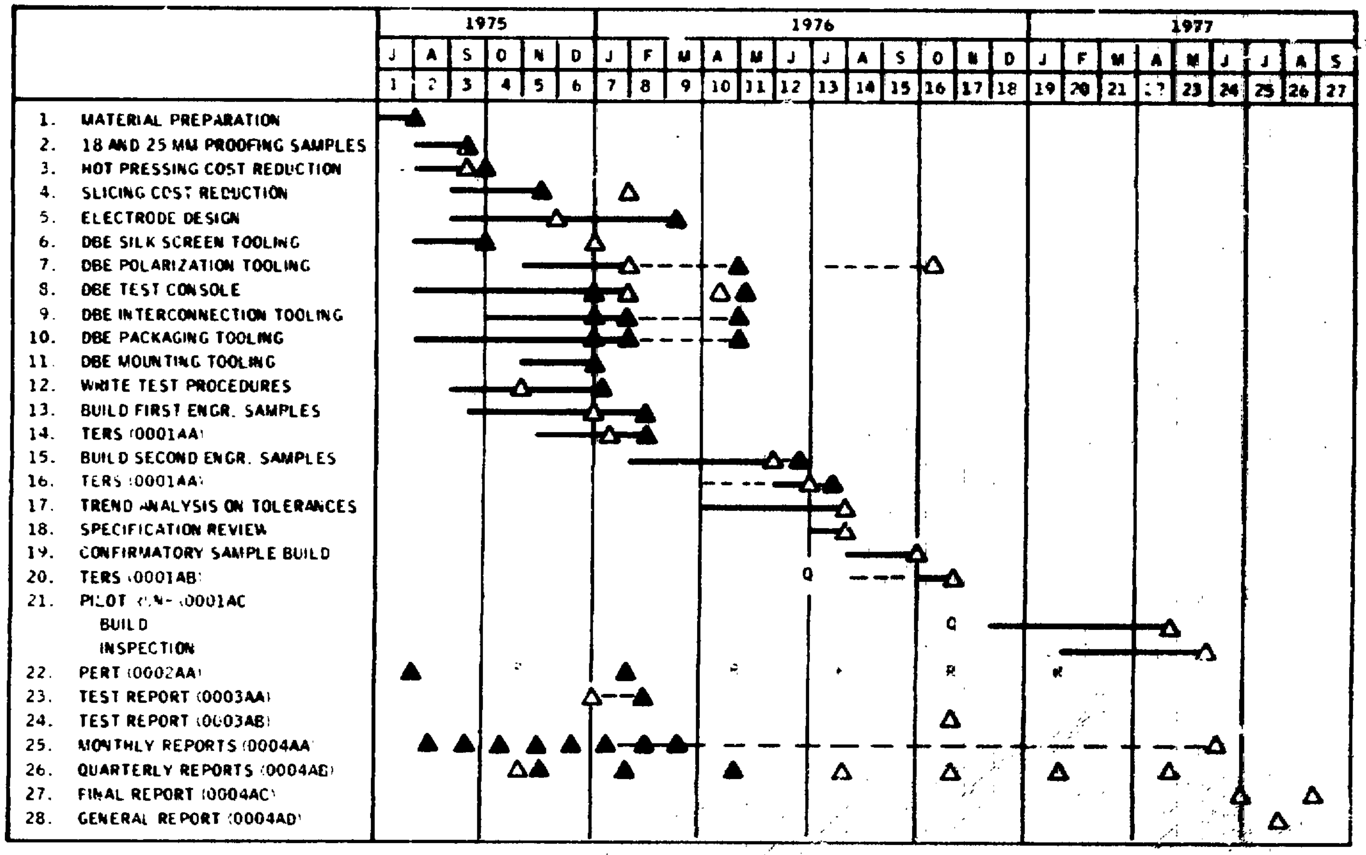
The first life test power supply was completed and put into service on May 14, 1976. Figure 3 is a photograph of the power supply, the 18mm test box and 25mm test box that can be used with each power supply. Figure 4 gives the circuit and chassis wiring diagram for the life test console.

Each console will drive up to six PETs at 125 percent of their rated input voltage and at the resonant frequency of each transformer. The tester continuously monitors the PET for shorts and abrupt changes in input current. The test console can also be used to moniter the performance of the PETs during vibration, humidity or other types of environmental testing.

A second console was also completed June 18, 1976 for use in testing the second engineering samples. This completes this task.

D. TASK 9-13

Completed previously.



DBE DESIGN BUILD AND EVALUATE
TERS TEST AND EVALUATION REVIEW AND SUBMIT
R REVISE QUARTERLY AS REQUIRED
Q REQUEST FOR APPROVAL TO START
△ ORIGINAL OR REVISED COMPLETION DATES
▲ ACTUAL COMPLETION DATES

Figure 2. Program Status Against Schedule

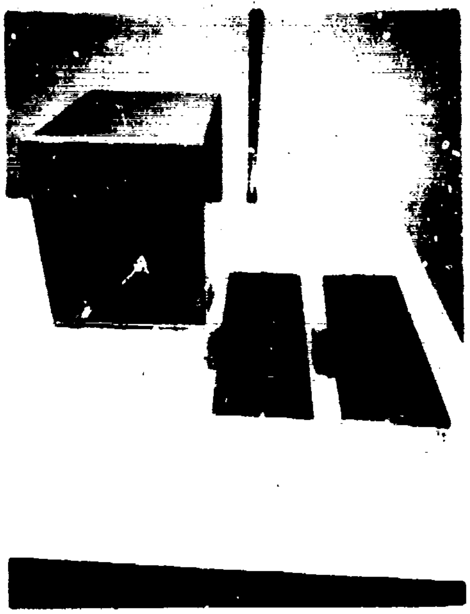


Figure 3. Life Test Console

E. TASK 14 - TEST AND EVALUATION OF FIRST ENGINEERING SAMPLES

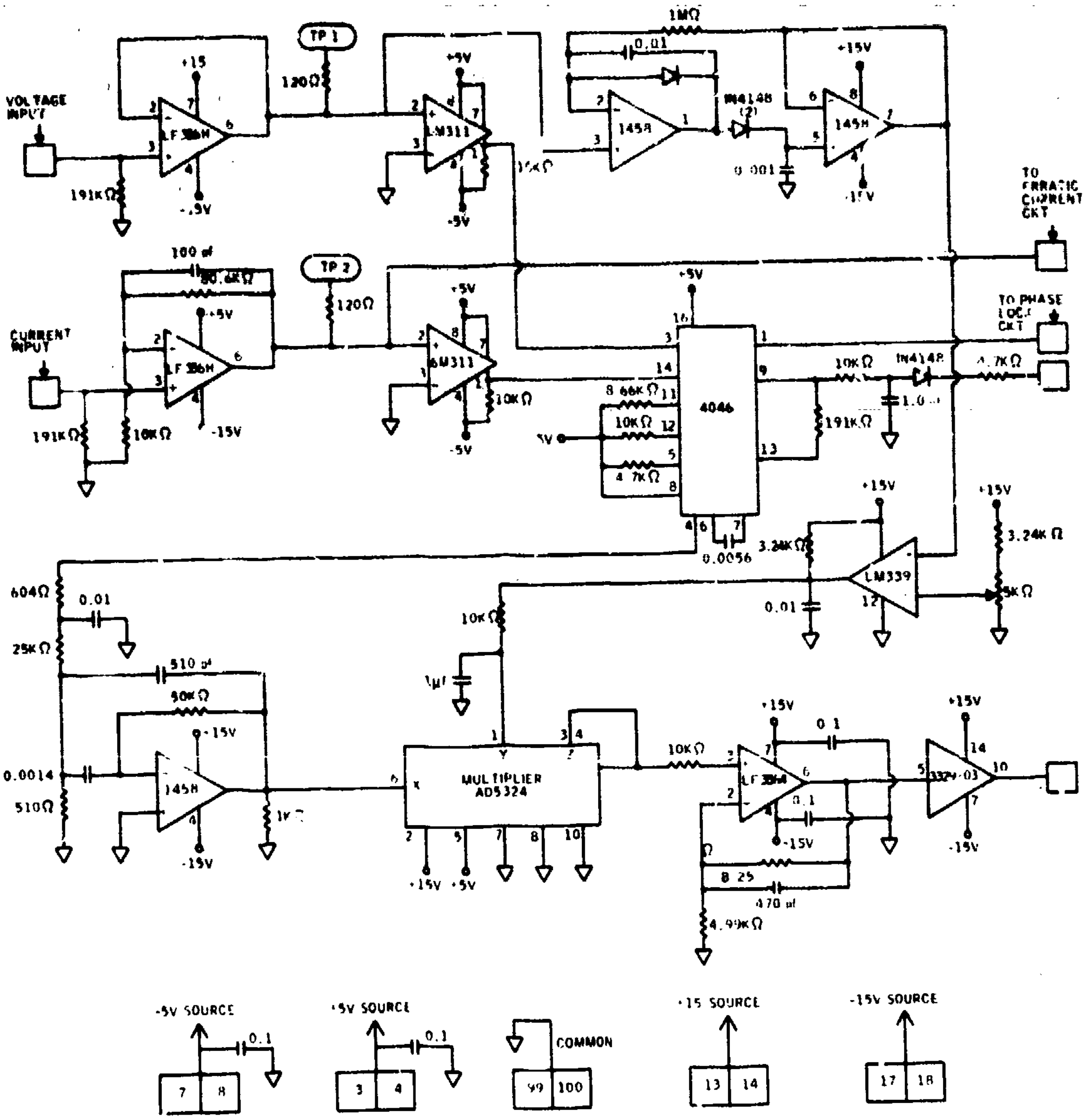
Life test on the three 18mm and three 25mm PETs has reached about 1250 hours without a failure. They will complete their 2000 hours of testing next quarter.

F. TASK 15 - SECOND ENGINEERING SAMPLE BUILD

Twelve 18mm and 12 25mm PETs were built and submitted to inspection on June 11, 1976. Process changes have been noted in Section II. The most significant changes incorporated in this build are: (1) elimination of the 18mm package problem, (2) elimination of the base side shorting bar and interconnections associated with the base side in both PET designs, (3) bonding of ceramic elements and (4) introduction of soldered gold ribbon leads.

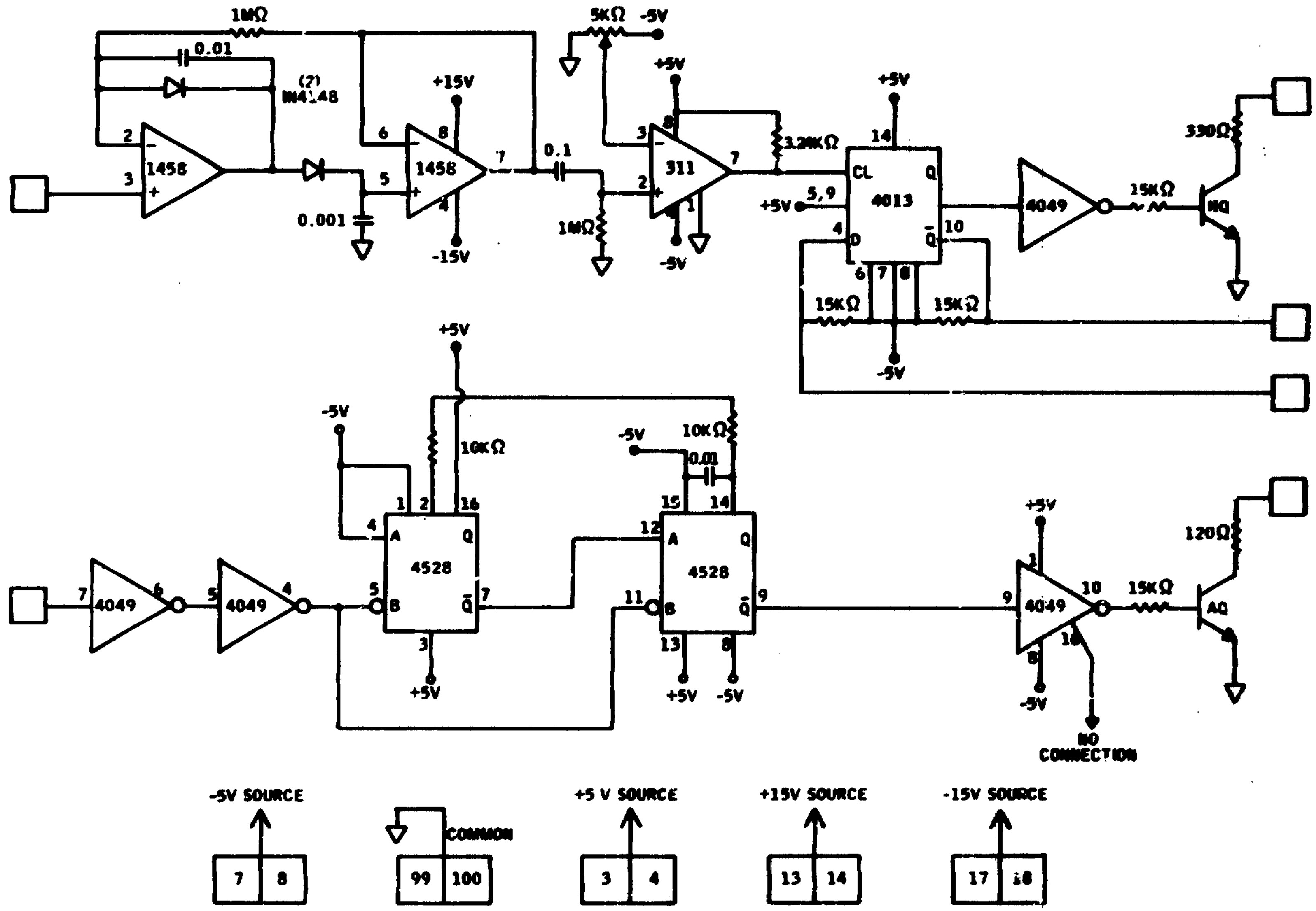
G. TASK 16 - TEST AND EVALUATION OF SECOND ENGINEERING SAMPLE

Figure 5 shows the 12 18mm PETs, and Figure 6, the 12 25mm PETs which were submitted as second engineering samples for test and evaluation. (The test sequence for the 18mm and 25mm PETs is indicated in Tables I and II, respectively.) The test results are summarized in Tables III and IV for the 18mm and 25mm PETs, respectively, while Table V



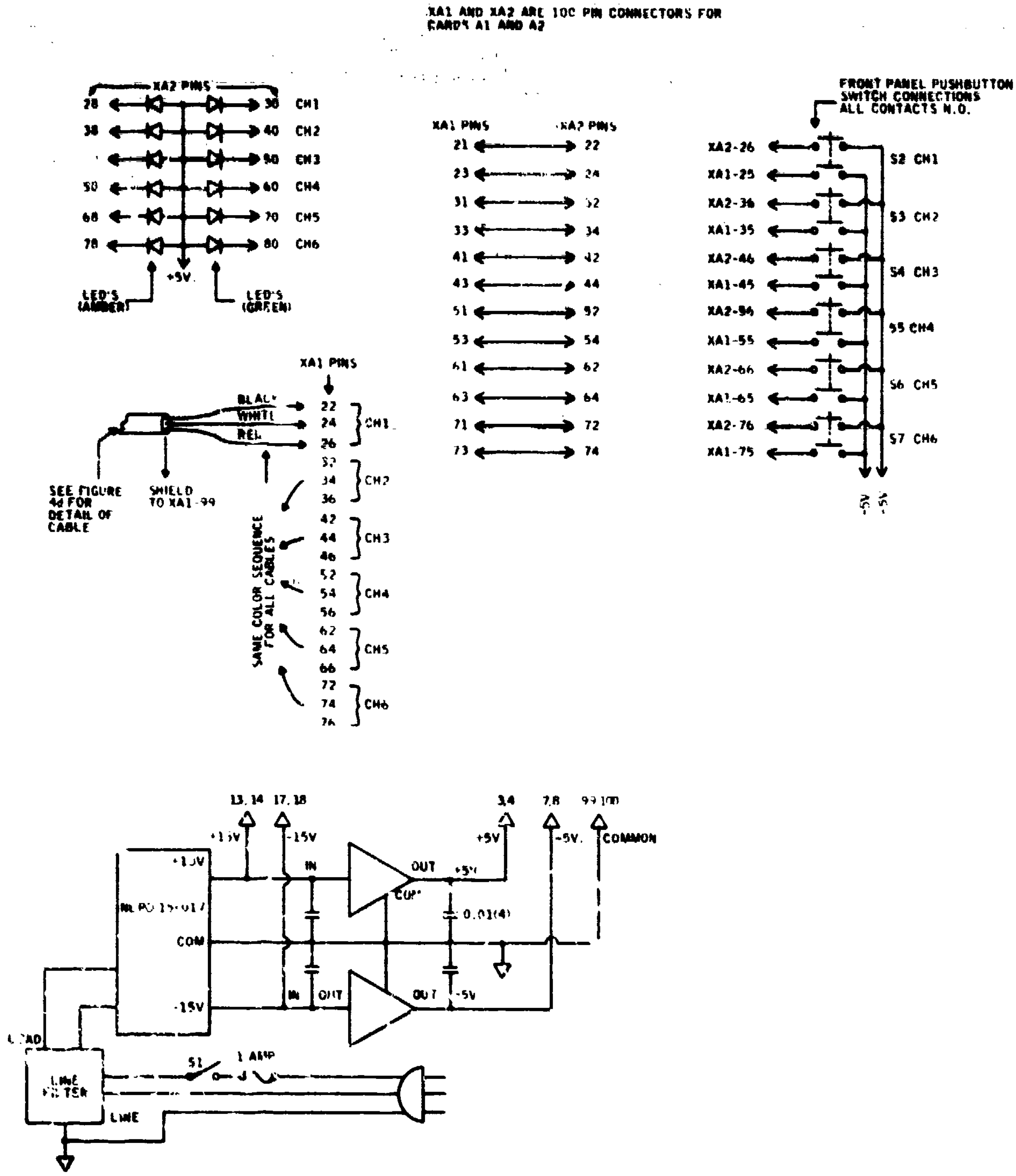
a. Input Card

Figure 4. Circuit Diagram for PET Life Tester



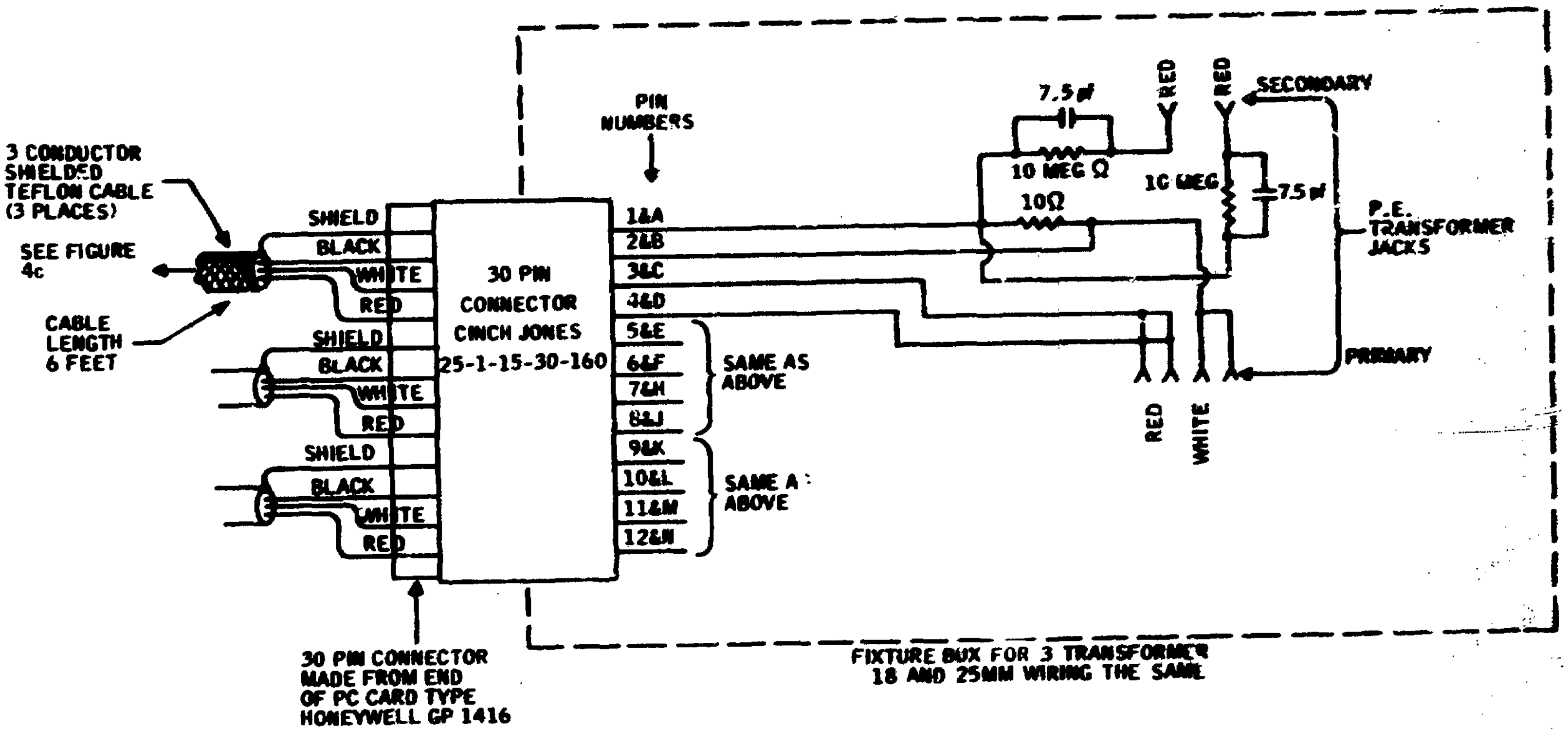
b. Output Card

Figure 4. Circuit Diagram for PET Life Tester (Continued)



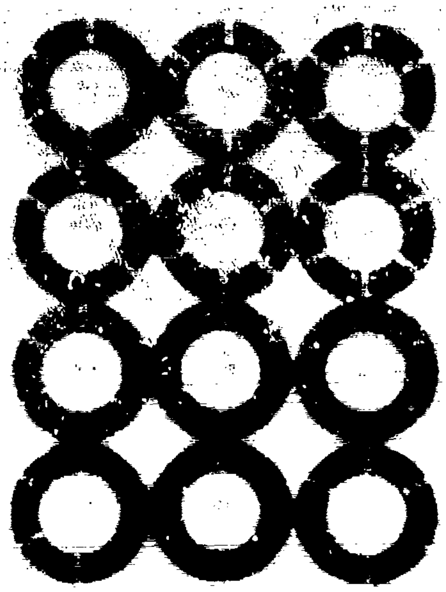
c. Chassis Connections

Figure 4. Circuit Diagram for PET Life Tester (Continued)

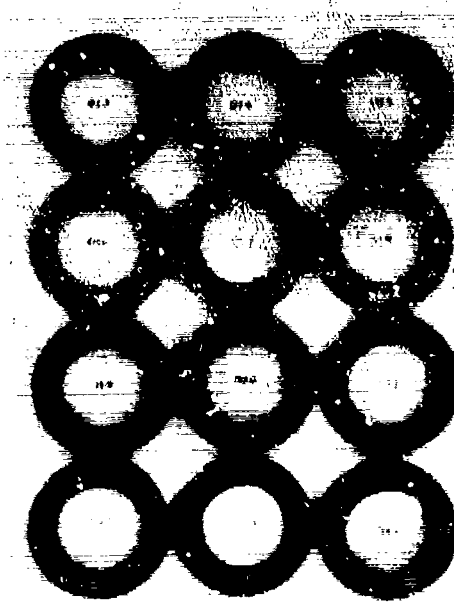


d. Cable and Fixture

Figure 4. Circuit Diagram for PET Life Tester (Concluded)

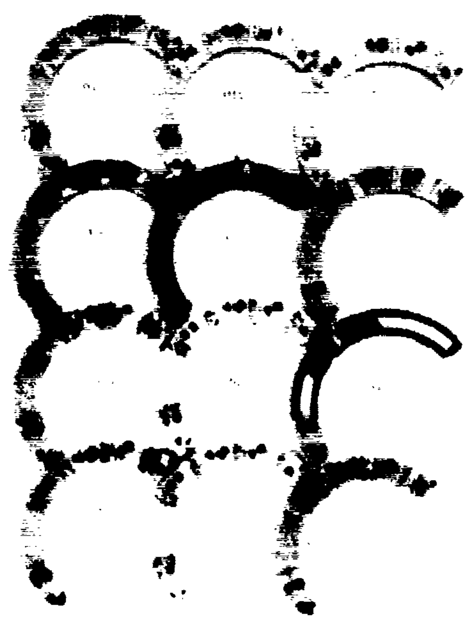


a. Top Side

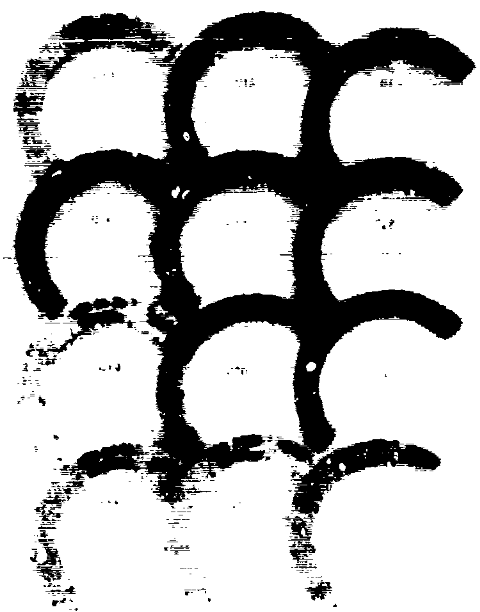


b. Base Side

Figure 5. 18mm PETs Submitted as Second Engineering Samples



a. Top Side



b. Base Side

Figure 6. 25mm PETs Submitted as Second Engineering Samples

Table I. 18mm Piezoelectric Transformer Test Sequence (Second Engineering Sample)

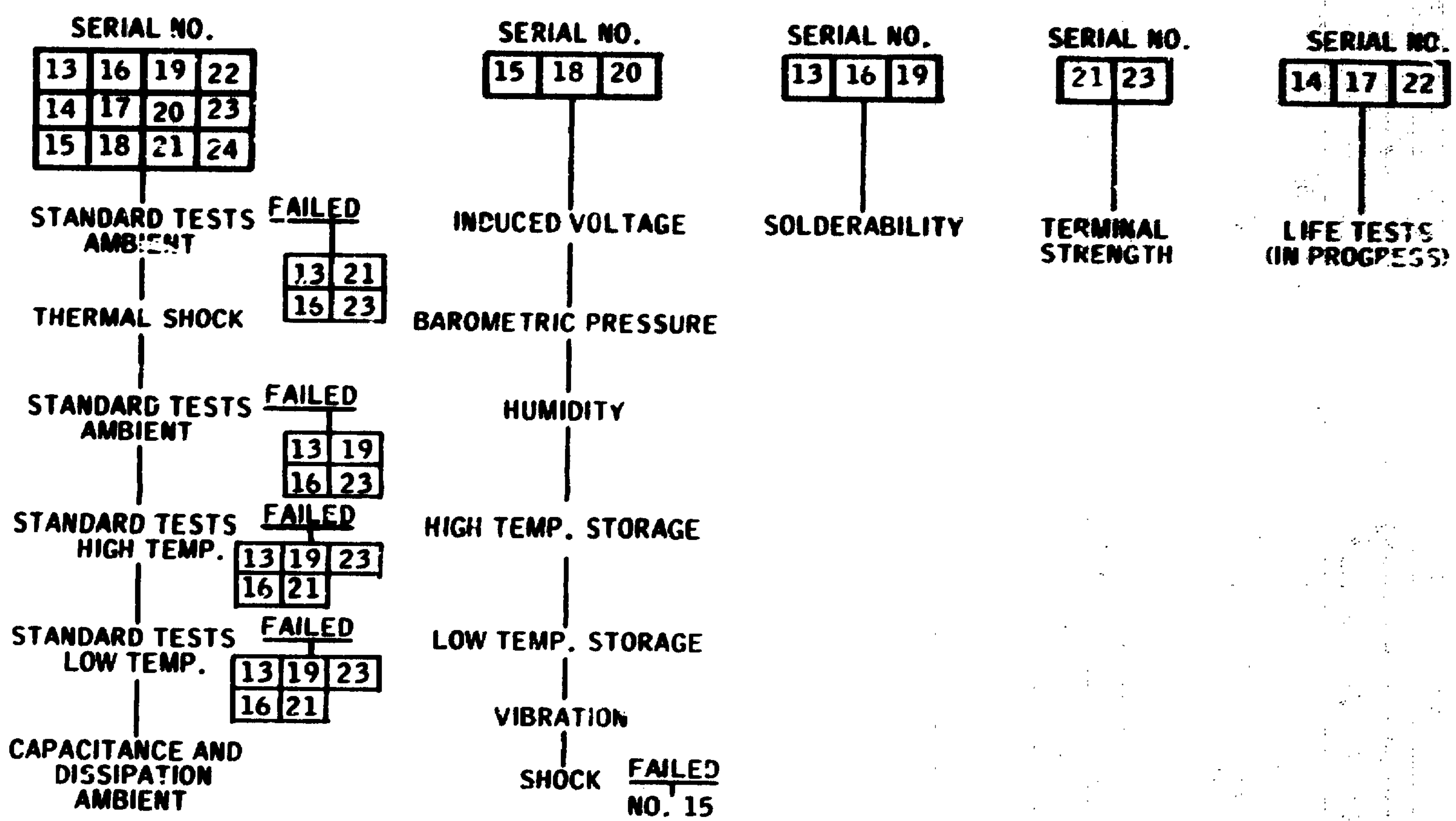


Table II. 25mm Piezoelectric Transformer Test Sequence (Second Engineering Sample)

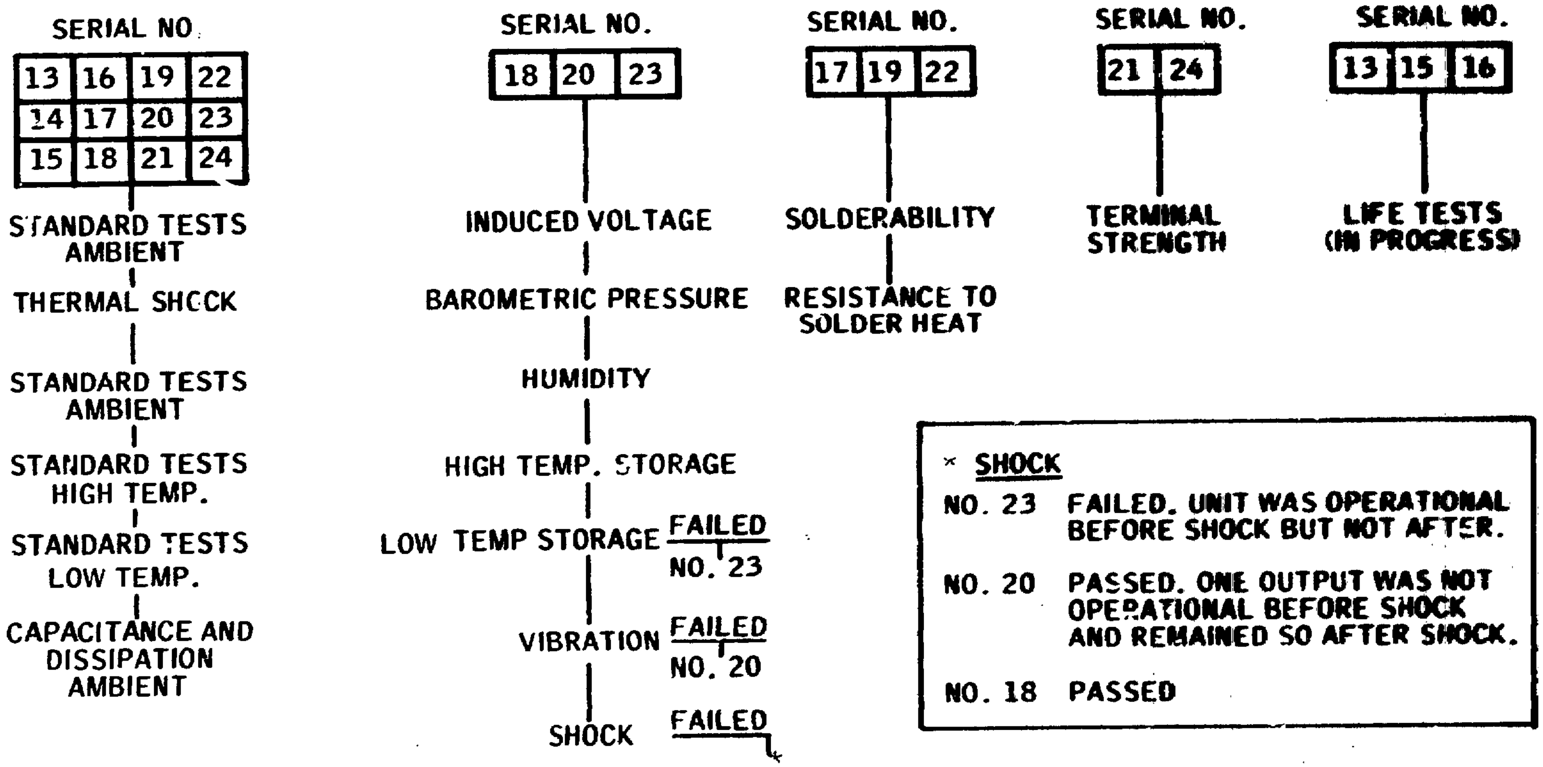


Table III. Summary of 18mm Second Engineering Sample Test and Evaluation Results

SCS-480 Page No.	Specified Parameter	18mm Requirement	013	014	015	016	017	018	019	020	021	022	023	024
3,1	Item Definition (Geometry)													
3,2	Material	Doped $Pb(ZrTi)O_3$												
3,3	Physical Characteristics	5 gms (max)												
3,4	Resistance to Soldering Heat	280 C/30 sec												
3,5	Solderability													
3,6	Terminal Strength	min 1/2 lb									OK		OK	
3,7	Induced Voltage	150%			OK			OK		OK				
3,8	Room Temp. Input Voltage	5 Volts (p-p)	4,77	4,63	4,37	4,73	4,11	4,47	4,59	3,47	4,36	4,02	4,78	4,31
3,8,1	Resonant Frequency	33,9 ± 0,2 kHz	39,724	32,791	31,863	29,669	31,766	31,875	38,917	32,476	31,553	31,665	30,335	30,992
3,8,2	Efficiency at Resonance	45% min	3,3	24,4	22,6	1,4	21,3	8,5	22,8	26,5	13,2	20,8		14,8
3,8,3	Voltage Step-up Ratio at V_{12}/V_3 Resonance	170 ± 17	23/23	100/98	127/128	19/21	156/147	67/75	142/0	240/243	98/100	157/162	0/0	105/112
3,8,4	Input Capacitance/ Dissipation	14,000 pf ± 4% 1,75% max	28,09/ 1,01			26,83/ 1,03		26,47/ 1,41		24,84/ 0,60	26,98/ 1,60	26,44/ 1,02	25,44/ 0,82	22,78/ 1,08
3,8,5	Secondary Capacitance Dissipation Factor	7,6 pf ± 4% 4,6% max	10,8/ 2,2	8,3/ 0,8	14,0/ 1,0	12,3/ 1,2	13,4/ 1,0	12,2/ 0,9	10,9/ 2,2	11,3/ 0,6				
3,9	High Temp. 52°C ± 2 C Input Voltage	5 Volts (p-p)	4,67	4,50	4,31	4,74	4,03	4,53	4,73	4,49	4,72	4,60		
3,9,1	Resonance Frequency	34,1 ± 0,2 kHz	38,669	32,088	31,837	38,686	31,070	32,020	38,682	[illegible]3,025	38,684	30,704		
3,9,2	Efficiency at Resonance	50% min	0,3	24,6	21,6		21,7	10,7		32,8		24,7		
3,9,3	Voltage Step-up Ratio at V_{12}/V_3 Resonance	170 ± 17	13/4	107/103	132/132	10/16	167/155	68/81		139/135		102/106		
3,10	Low Temp. - 54 ± 2°C Input Voltage	5 Volts (p-p)	4,69	4,81	4,55	4,74	4,47	4,55	4,84	4,28	4,33	4,80		4,73
3,10,1	Resonance Frequency	33,3 ± 0,2 kHz	26,567	32,654	31,672	38,705	31,085	30,932	38,733	31,576	30,648	31,771		30,566
3,10,2	Efficiency at Resonance	25% min		15,5	17,9		14,4	4,0		15,4	7,4	18,7		9,6
3,10,3	Voltage Step-up Ratio at V_{12}/V_3 Resonance	85 ± 8,5	10/22	56/54	93/98	14/10	96/88	43/47	83/0	114/114	62/50	63/62		52/54
3,11	Thermal Shock	No Damage	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
3,12	High Temp. Storage	71°C 2 hrs min			OK			OK		OK				
3,13	Low Temp. Storage	-65°C 2 hr min			OK			OK		OK				
3,14	Humidity	95% RH at 52°C 6 hrs min			OK			OK		OK				
3,15	Mechanical Shock	per 4,5,13			*Failed			OK		OK				
3,16	Mechanical Vibration	per 4,5 12			OK			OK		OK				
3,17	Reduced Barometric Press.	3,44 in. for 1 hr			OK			OK		OK				

* PET unit crushed by mounting fixture.

Table IV. Summary of 25mm Second Engineering Sample Test and Evaluation Results

SCS-480 Page No.	Specified Parameter	18mm Requirement	013	014	015	016	017	018	019	020	021	022	023	024
3.1	Item Definition (Geometry)													
3.2	Material	Doped $Pb(ZrTi)O_3$												
3.3	Physical Characteristics	5 gms (max)												
3.4	Resistance to Soldering Heat	280°C/30 sec					OK		OK			OK		
3.5	Solderability						OK		OK			OK		
3.6	Terminal Strength	min 1/2 lb									OK			OK
3.7	Induced Voltage	150%						OK		OK			OK	
3.8	Room Temp. Input Voltage	5 Volts (p-p)	4.50	4.49	4.46	4.46	4.58	4.58	4.68	4.58	4.67	4.83	4.54	4.65
3.8.1	Resonant Frequency	33.9 ± 0.2 kHz	30.475	30.058	30.541	30.275	29.611	30.534	30.822	30.644	30.383	29.996	30.157	30.350
3.8.2	Efficiency at Resonance	45% min	56.0	50.8	58.4	57.7	30.8	44.4	45.9	45.3	34.2	12.5	22.9	26.5
3.8.3	Voltage Step-up Ratio at V_{12}/V_3 Resonance	170 ± 17	177/176	170/170	188/191	184/189	114/124	148/136	120/123	145/144	110/109	72/68	112/102	111/124
3.8.4	Input Capacitance/ Dissipation	14,000 pf ± 4% 1.75% max	31.22/ 0.90	33.83/ 0.67	30.63/ 0.89	32.04/ 0.80	32.34/ 1.00	32.09/ 0.77	21.64/ 0.62	34.62/ 0.47	22.77/ 0.63	32.39/ 0.61	70.55/ 0.69	30.86/ 0.70
3.8.5	Secondary Capacitance Dissipation Factor	7.6 pf ± 4% 4.6% max	14.2/ 0.82	6.6/ 0.84	10.4/ 0.66	18.9/ 0.90	14.4/ 0.87	6.6/ 0.88	13.7/ 0.[illegible]	13.7/ 0.78	13.7/ 1.19	16.5/ 0.84	10.1/ 0.78	10.5/ 0.46
3.9	High Temp. 82°C ± 2° Input Voltage	5 Volts (p-p)	4.42	4.49	4.40	4.39	4.52	4.45	4.61	4.44	4.61	4.69	4.54	4.44
3.9.1	Resonance Frequency	34.1 ± 0.2 kHz	30.709	30.282	30.756	30.503	29.519	30.731	30.801	30.804	30.439	30.074	30.289	30.321
3.9.2	Efficiency at Resonance	50% min	58.9	51.7	57.7	57.1	20.7	48.0	30.9	48.1	36.9	9.3	24.7	33.1
3.9.3	Voltage Step-up Ratio at V_{12}/V_3 Resonance	170 ± 17	197/198	171/173	197/200	197/200	102/108	170/165	117/113	175/174	125/125	56/54	115/108	152/135
3.10	Low Temp. -54 ± 2°C Input Voltage	5 Volts (p-p)	4.58	4.54	4.55	4.54	4.60	4.57	4.74	4.55	4.73	4.68	4.60	4.59
3.10.1	Resonance Frequency	33.3 ± 0.2 kHz	29.418	29.128	29.359	29.201	28.845	29.464	29.814	29.621	29.311	28.295	29.473	29.324
3.10.2	Efficiency at Resonance	25% min	21.7	20.5	11.3	18.7	25.3	10.5	23.9	9.4	23.8	9.0	17.2	16.[illegible]
3.10.3	Voltage Step-up Ratio at V_{12}/V_3 Resonance	85 ± 8.5	100/99	105/100	77/72	100/96	103/107	68/73	86/77	69/67	82/82	57/54	113/82	92/78
3.11	Thermal Shock	No Damage	OK	OK	OK	OK	OK	OK	*OK	OK	OK	OK	OK	OK
3.12	High Temp. Storage	71°C - 2 hrs min						OK		OK			OK	
3.13	Low Temp. Storage	-65°C 2 hr min						OK		OK			OK	
3.14	Humidity	95% RH at 52°C 6 hrs min						OK		OK			OK	
3.15	Mechanical Shock	per 4.5.13						OK		OK			**Failed	
3.16	Mechanical Vibration	per 4.5.12						OK		***Failed			OK	
3.17	Reduced Barometric Press.	3.44 in. for 1 hr						OK		OK			OK	

* V_3 open, V_{12} OK
** PET crushed by mounting fixture
*** V_{12} open, V_3 OK

Table V. 18mm Piezoelectric Transformer Summary of Test Results — Second Engineering Sample

	S/N	Resonant Frequency (kHz)	Percent Efficiency*	Step-up Ratio* 12	Step-up Ratio* 3	Input Capacitance (nf)	Input Dissipation (%)	Output Capacitance** 12 (pf)	Output Dissipation 12 (%)	Output Capacitance** 3 (pf)	Output Dissipation 3 (%)
Room Temperature Prior to Environments	013	29,730	4.3	47.2	26.8						
	014	32,736	17.1	145.6	144.8						
	015	33,001	20.7	143.6	148.4						
	016	31,600	4.5	32.0	25.6						
	017	32,183	20.0	138.4	134.8						
	018	32,202	9.3	64.8	53.6						
	019	32,280	18.4	151.2	162.8						
	020	32,579	19.0	180.4	180.0						
	021	30,981	-	29.6	16.0						
	022	32,174	19.0	141.6	148.0						
	023	33,888	-	12.8	20.4						
	024	31,410	10.3	72.8	82.8						
Post-Temp. Shock (Ambient)	013	29,724	-	21.6	31.2	28.09	1.01	18.56	2.12	19.10	2.30
	014	32,701	22.8	92.4	90.4	-	-	16.93	0.79	15.57	0.83
	015	31,863	19.9	110.8	112.0	-	-	21.67	0.00	22.31	1.09
	016	29,680	-	17.6	20.0	26.83	1.03	20.44	1.14	20.13	1.17
	017	31,768	17.5	128.4	120.8	-	-	20.33	0.89	22.55	1.07
	018	31,875	9.9	59.6	66.8	26.47	1.41	20.60	1.04	19.83	0.83
	019	38,017	-	130.4	0	-	-	16.78	2.08	21.07	2.25
	020	32,478	18.4	166.8	168.8	24.84	0.80	18.81	0.35	19.82	0.82
	021	31,553	11.5	85.2	87.2	26.98	1.60	20.15	0.97	20.15	0.67
	022	31,863	16.7	136.0	130.4	26.44	1.02	20.05	0.89	18.50	0.70
	023	39,335	-	8.8	4.0	25.44	0.82	19.89	-	-	-
	024	30,992	12.7	90.4	96.4	27.78	1.08	15.24	0.86	14.45	0.8
Post-Temp. Shock (High Temp.)	013	38,669	-	12.0	4.0						
	014	32,988	22.6	98.0	94.8						
	015	31,837	18.6	113.6	113.6						
	016	38,606	-	9.2	15.2						
	017	31,970	17.5	134.8	125.2						
	018	32,020	9.7	61.2	73.2						
	019	38,682	-	9.2	0.4						
	020	33,025	29.4	125.2	120.8						
	021	38,684	-	-	-						
	022	30,704	22.7	94.0	97.6						
	023	-	-	-	-						
	024	-	-	-	-						
Post-Temp. Shock (Low Temp.)	013	28,567	-	9.2	20.4						
	014	32,654	14.9	54.4	52.0						
	015	31,672	16.6	84.4	88.8						
	016	38,705	-	13.2	9.6						
	017	31,085	12.9	86.0	78.8						
	018	30,932	3.6	38.8	42.4						
	019	38,733	-	2.0	-						
	020	31,576	13.2	97.6	97.6						
	021	30,648	6.9	53.6	43.2						
	022	31,771	17.9	60.0	59.6						
	023	-	-	-	-						
	024	30,566	-	48.8	50.8						

* Values have not been corrected for lower input voltage levels.
** Values have not been corrected for about 8 pf stray capacitance.

Table V. 18mm Piezoelectric Transformer Summary of Test Results — Second Engineering Sample (Concluded)

Test	S/N	Resonant Frequency (kHz)	Percent Efficiency *	Step-up Ratio 12 *	Step-up Ratio 3 *	Input Capacitance (nf)	Input Dissipation (%)	Output Capacitance 12 ** (pf)	Output Dissipation 12 (%)	Output Capacitance 3 (pf)	Output Dissipation 3 (%)
Induced Voltage	015	OK	OK	OK	OK						
	018	OK	OK	OK	OK						
	020	OK	OK	OK	OK						
Baro-metric Pressure	015	32.440	27.0	90.8	86.8						
	018	32.340	8.8	48.8	52.0						
	020	32.520	18.4	171.6	173.2						
Post-Humidity	015	32,247	25.1	82.0	82.8						
	018	32,124	9.1	54.4	45.2						
	020	32,395	16.3	148.0	146.8						
Post-Temp. Storage (High)	015	32,581	9.8	99.2	94.8						
	018	32,195	17.6	73.4	61.6						
	020	32,631	27.6	170.4	170.0						
Post-Temp. Storage (Low)	015	31,803	4.1	56.8	55.2						
	018	31,327	12.0	47.2	36.0						
	020	31,996	20.4	96.0	92.8						
Post-Vibration	015	32,457	26.6	88.8	87.6						
	018	32,342	9.1	54.4	44.0						
	020	32,617	18.5	175.2	173.4						
Post-Shock	015	30,141	-	12.4	9.6						
	018	31,274	5.8	56.0	40.4						
	020	32,653	18.2	166.0	162.8						
Terminal Strength	021	OK	OK	OK	OK						
	023	OK	OK	OK	OK						
Solder-ability	013	OK	OK	OK	OK						
	016	OK	OK	OK	OK						
	019	OK	OK	OK	OK						
Life Tests	014	33,172	25.6	105.2	102.8	750 Hours					
	017	32,189	18.9	140.4	127.6	750 Hours					
	022	32,190	19.4	145.6	130.4	750 Hours					

* Values have not been corrected for lower input voltage levels.
** Values have not been corrected for about 8 pf stray capacitance.

Table VI. 25mm Piezoelectric Transformer Summary of Test Results — Second Engineering Sample

	S/N	Resonant Frequency (kHz)	Percent Efficiency*	Step-up Ratio 12*	Step-up Ratio 3*	Input Capacitance (nf)	Input Dissipation (%)	Output Capacitance 12** (pf)	Output Dissipation 12 (%)	Output Capacitance 3** (pf)	Output Dissipation 3 (%)
Room Temperature Prior to Environments	013	30,080	57.8	192.8	196.4						
	014	30,303	52.3	177.6	180.0						
	015	30,780	55.5	181.2	186.0						
	016	30,533	53.9	184.4	180.2						
	017	29,698	20.7	102.4	93.6						
	018	30,635	44.2	161.2	148.0						
	019	30,815	42.2	122.4	125.6						
	020	30,755	47.2	168.8	166.8						
	021	30,907	46.5	131.6	120.2						
	022	30,159	23.3	103.6	103.8						
	023	30,130	26.2	116.0	120.8						
	024	30,476	35.0	103.6	114.4						
Post-Temp. Shock (Ambient)	013	30,473	50.4	159.8	158.4	31.22	0.90	22.08	0.76	21.76	0.88
	014	30,058	45.8	152.8	152.8	33.83	0.67	10.34	0.08	18.90	0.70
	015	30,541	52.1	166.4	170.4	30.83	0.89	18.80	0.60	18.03	0.71
	016	30,275	51.5	164.4	168.4	32.04	0.80	27.80	0.80	26.	0.99
	017	29,611	26.2	104.8	113.6	52.34	1.00	23.00	0.80	[illegible]	0.94
	018	30,534	40.7	135.5	124.4	32.09	0.77	10.71	0.97	[illegible]	0.79
	019	30,822	43.0	120.8	115.2	21.64	0.62	21.57	[illegible]	[illegible]	1.06
	020	30,044	41.5	132.8	137.0	34.62	0.47	22.60	0.68	[illegible]	0.80
	021	30,383	31.9	103.2	102.0	22.77	0.63	21.32	1.28	22.01	1.00
	022	30,996	11.5	66.2	63.2	32.39	0.61	25.43	0.79	23.64	0.88
	023	30,157	20.8	102.6	92.8	30.55	0.69	18.70	0.70	17.42	0.86
	024	30,350	34.0	103.2	115.2	30.86	0.70	18.61	0.53	18.34	0.38
Post-Temp. Shock (High Temp. Operation)	013	30,709	52.1	174.0	174.8						
	014	30,282	46.4	163.2	155.2						
	015	30,796	50.8	173.2	176.0						
	016	30,503	50.3	173.2	176.4						
	017	29,510	18.7	92.0	98.0						
	018	30,731	42.7	150.6	147.2						
	019	30,801	28.5	108.0	104.0						
	020	30,804	42.7	155.2	154.8						
	021	30,439	34.0	114.8	115.6						
	022	30,074	8.7	52.8	50.4						
	023	30,280	22.5	104.4	98.4						
	024	30,321	29.4	135.2	120.0						
Post-Temp. Shock (Low Temp. Operation)	013	29,418	19.0	91.2	90.8						
	014	29,128	18.7	95.2	90.8						
	015	29,359	10.3	70.0	65.6						
	016	29,201	17.0	90.4	87.2						
	017	28,845	23.3	94.4	78.0						
	018	29,484	9.6	62.0	66.4						
	019	29,814	22.7	81.2	72.8						
	020	29,621	8.52	62.4	61.2						
	021	29,311	22.3	77.6	77.2						
	022	28,205	4.4	53.2	50.8						
	023	29,473	15.8	82.8	75.2						
	024	29,734	15.1	84.8	72.0						

* Values have not been corrected for lower input voltage levels.
** Values have not been corrected for abo. 8 pf of stray capacitance.

Table VI. 25mm Piezoelectric Transformer Summary of Test Results — Second Engineering Sample (Concluded)

	S/N	Resonant Frequency (kHz)	Percent Efficiency*	Step-up Ratio$_{12}$*	Step-up Ratio$_{3}$*	Input Capacitance (nf)	Input Dissipation (%)	Output Capacitance$_{12}$ (pf)	Output Dissipation$_{12}$ (%)	Output Capacitance$_{3}$ (pf)	Output Dissipation$_{3}$ (%)
Induced Voltage	018	OK	OK	OK							
	020	OK	OK	OK							
	023	OK	OK	OK							
Barometric Pressure	018	30,607	45.4	146.8	161.2						
	020	30.781	48.2	164.8	166.0						
	023	30,385	29.0	122.8	116.4						
Humidity	018	30,504	41.1	142.4	129.2						
	020	30,566	42.8	143.4	142.0						
	023	30,546	24.4	68.0	69.6						
Post-Temp. Storage (High)	018	30,916	13.8	81.2	72.4						
	020	30,575	9.9	77.6	72.8						
	023	30,457	21.1	58.4	59.2						
Post-Temp. Storage (Low)	018	29,415	15.4	70.8	61.2						
	020	29,890	20.2	95.2	92.0						
	023	29,996	6.0	63.2	14.8						
Vibration	018	30,830	33.6	120.0	105.6						
	020	31,576	35.1	18.4	213.2						
	023	30,449	24.5	107.6	107.2						
Post-Shock	018	30,917	[illegible]	103.6	91.6						
	020	31,034	15.9	10.8	110.0						
	023	29,702	[illegible]	31.2	23.6						
Solderability	17	OK	OK	OK	OK						
	19	OK	OK	OK	OK						
	22	OK	OK	OK	OK						
Resist. to Solder Heat	17	Dipped too deep									
	19	30,657	32.0	100.8	100.4						
	22	No physical damage but unit was dropped on the floor prior to the test and it was no longer working at the time it was dipped into the solder.									
Terminal Strength	21	OK	OK	OK	OK						
	24	OK	OK	OK	OK						
Life Tests	13	In progress									
	15										
	16										

Values have not been corrected for lower input voltage levels.
Values have not been corrected for about 8 pf of stray capacitance.

and VI give the detail test data obtained. The results of the 18 and 25mm second engineering sample build are discussed for each SCS-480 requirement below:

1. Physical Characteristics: The weight of the revised 18mm and 25mm package PETs was 4.2 and 4.85 grams, respectively. The redesigned 18mm case performed quite satisfactorily and the warpage of the 25mm case was corrected by annealing. The wall thickness of the top and base 25mm cases was found to be oversize by 0.006 and 0.015 inch, which led to the assembled case being 0.010 inch oversize in outside thickness and undersize about 0.010 inch inside clearance. The injection mold die will be reworked to correct this problem. A package weight reduction of about 0.3 gram will be obtained and thus the 25mm PETs will weigh about 4.5 grams.

2. Resistance to Soldering Heat: As with the first engineering samples, when only the terminals were in contact with the solder, the packaged units survived the soldering heat resistance tests. One 25mm unit (No. 017) was dipped too far into the flux/solder bath and the face of the top case was partially melted.

3. Solderability: All units passed the solderability tests.

4. Terminal Strength: The terminals on two 18mm (021 and 023) and one 25mm (021) units were pulled to destruction. Typical pull strengths were 10 to 12 pounds. After several pounds of loading, the terminals remain tight and secure to the package.

5. Induced Voltage: No failure to the induced voltage test occurred.

6. Thermal Shock: All 12 25mm and seven of eight 18mm PET package units that were initially operational functioned after the specified thermal shock treatment. One 18mm unit (019), which functioned prior to thermal shock, contained only one output afterwards while another 18mm unit (021), which was unsatisfactory prior to thermal shock, produced outputs from both secondaries.

7. High Temperature Storage: All 18mm and 25mm PETs passed this test.

8. Low Temperature Storage: All 18mm and 25mm PETs passed this test.

9. Humidity: All 18mm and 25mm PETs passed the required humidity test.

10. Mechanical Vibration: All 18mm and 25mm PETs passed this test except one V_{12} output in a 25mm unit (020).

11. **Mechanical Shock:** One 18mm and one 25mm PET unit failed to operate after the mechanical shock test; however, all six units were partially crushed during the mounting of the PETs in the test fixture. Rubber mounting pads will be added to the test fixture to prevent future damage.

12. Barometric Pressure: All 18mm and 25mm PET units passed the reduced barometric pressure test.

13. Life Test: Three 18mm (014, 017, 022) and three 25mm (013, 015, 016) PET units were selected and placed on life test June 7, 1976. These units reached 750 hours of testing without failure.

14. Electrical Performance: Eight of the 18mm PETs and 11 of the 25mm PETs produced significant output voltage.

H. 18mm PET

Three 18mm PETs were damaged during the final stages of closing the packages, while one unit was apparently damaged during bonding and insertion into the top case.

Seven of the eight operational 18mm PETs (S/N 014, 015, 017, 018, 020, 021 and 022) were of similar design, while S/N 024 contained the single primary single secondary type "M" electrode design discussed last quarter[3]. Only the standard electroded packages are discussed below.

The average resonant frequency of the 18mm units was 32.15 kHz with a range of 31.55 to 32.79 kHz, which is slightly higher than the first engineering samples. The input capacitance was 25.07 nf, which is lower than the 34.93 nf obtained with wide electroded first engineering samples. The secondary capacitance and dissipation of 12 pf and 0.9 percent were about the same as the previous set of PETs. The input dissipation of 1.0 percent was also about the same as previously.

The room temperature voltage step-up ratio was met by only two PETs, S/N 020 and 022, while S/N 017 contained one acceptable output and a second output only slightly below the minimum requirement of 153. The high temperature performance was normally equal to or slightly better than the room temperature; for instance, both outputs of S/N 017 were satisfactory. However, the output of S/N 020 and 022 decreased significantly. Poor contact of the PETs terminals to the test fixture probably explains the low output of S/N 015, 017 and 020. In fact, the drop in output at -54°C was not as great as had been anticipated.

The efficiency at resonance at all temperatures was less than desired. At room temperature and 52°C the best units were only 24 to 26 percent as opposed to the desired 45 percent, while at -54°C, 15 to 18 percent efficiency was obtained instead of the desired 25 percent minimum. Thus, at least a part of low output and efficiency of the first engineering samples was not a case problem, but a design/testing problem. Work is currently under way to determine (1) the reason for such low efficiencies, and (2) methods to correct this problem.

1. 25mm PET

The 25mm PETs had an average input capacitance of 32 nf as opposed to the 44 nf wider electrode, first engineering samples. Input dissipation was 0.8 percent, which was about the same as the first engineering samples. Resonant frequency of the second engineering samples averaged 30.5 kHz as opposed to 30.2 kHz for the previous samples.

The voltage step-up requirement at room temperature and 52°C was met by six of the 25mm PETs. S/N 013, 014, 015, 016, 018 and 020. At -54°C, S/N 015 and 018 were slightly below the minimum ratio for a total of 10 good units. The efficiency at resonance at room temperature and 52°C was greater than 50 percent and three others were about 45 percent. At -54°C, five units had an efficiency between 20 and 26 percent. At -54 and +52°C, temperatures, the resonant frequency was about 1.0 kHz lower and 0.2 kHz higher, respectively, than the PETs' room temperature value.

SECTION IV
CONCLUSIONS

Both of the 18mm and 25mm package designs meet the physical and environmental requirements of this program and therefore no further changes need to be made in the packaging approach. The 25mm PETs appear to be meeting their electrical performance requirements, thus this item is ready for the confirmatory build phase. The low efficiency and marginal voltage step-up ratio indicate the need for further studies on the 18mm design.

SECTION V
RECOMMENDATIONS

Additional 18mm units need to be built to determine how to improve their voltage step-up ratio and efficiency before the confirmatory build phase is started.

SECTION VI
REPORTS

The third quarterly report on this program was approved and has been published and distributed during this report period. No other reports or publications have been made on this program.

SECTION VII
IDENTIFICATION OF PERSONNEL

During the fourth quarter of this program, the following personnel worked the indicated hours in their area of responsibility. No new professional persons, whose backgrounds have not been given previously[1, 2], were used.

Individual	Responsibility	Hours
W. B. Harrison*	Program Manager	70
W. H. Kammeyer*	Production Engineer, Ceramic Manufacture and PET Assembly	26
L. F. Hiltner*	Quality Engineer	63
M. P. Murphy	Ceramic Technician Ceramic Manufacturing	261
M. R. Sandberg	Ceramic Technician Package Assembly	18
Miscellaneous	Production	22
R. Ripley	Insp. PET Testing	29
E. Jackman	Instrumentation Technician Life Test Circuits	17
P. Schansberg	Instrumentation Technician Life Test Circuits	90
R. Erickson	Drafting	31

*Backgrounds given in First and Second Quarterly Reports

APPENDIX A
PARTS AND DRAWINGS

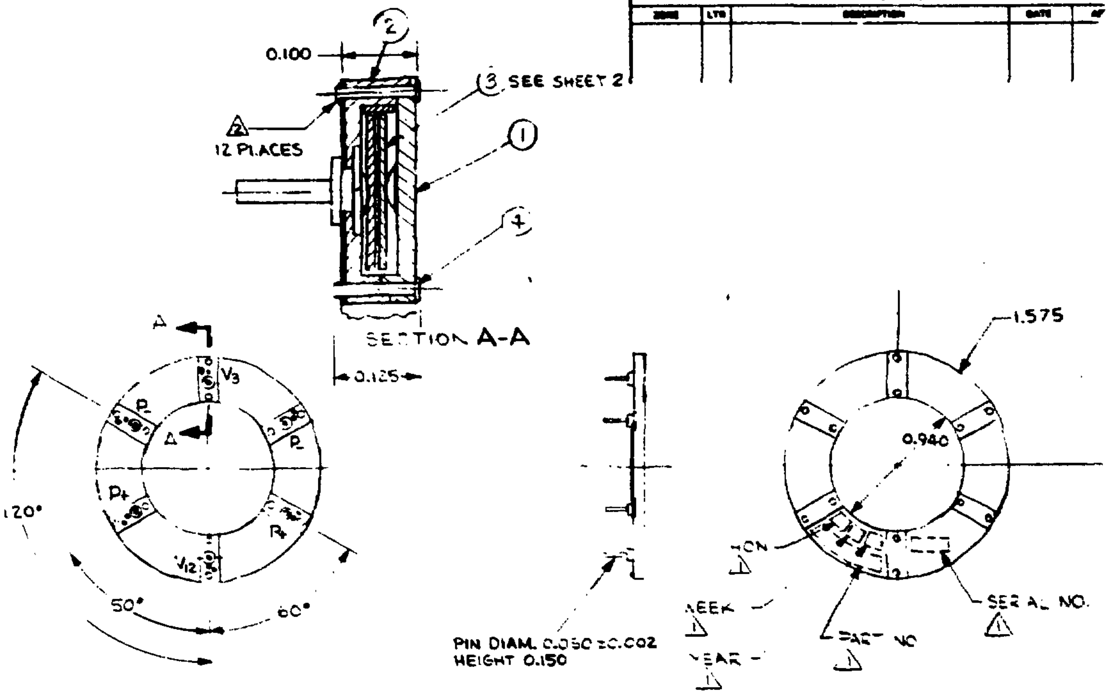
18mm Parts and Drawing List

Drawing No.	Drawing Title
28100560	Piezoelectric Transformer (18mm)
28100578	Case, Base
28100581	Case, Base Molding (18mm)
28100576	Element, Piezoelectric
28100577	Case, Top
28100579	Shorting Bar (18mm)
28100580	Case, Top Molding (18mm)
28100570-002	Pin
28100572	Terminal

25mm Parts and Drawing List

Drawing No.	Drawing Title
28100561	Piezoelectric Transformer (25mm)
28100568	Case, Base
28100575	Case, Base (Molded)
28100571	Element, Piezoelectric
28100569	Case, Top (25mm)
28100573	Shorting Bar (25mm)
28100574	Case, Top Molded (25mm)
28100570-001	Pin
28100570-003	Negative Terminal Pin
28100572	Terminal

PART NO. 28100560-001



NOTES:

1 - MARK .06 HIGH UNLESS OTHERWISE SPECIFIED

2 - SOLDER:-

3 - ELECTRICAL TESTS - SEE SHEET 3

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	REMARKS	ITEM NO
12	28100570 -002	PIN		4
2	28100576 -001	ELEMENT	SEE SHEET 2	3
1	28100577 -001	CASE, TOP		2
1	28100578 -001	CASE, BASE		1

TOLERANCES UNLESS NOTED OTHERWISE: X, XX, XXX ±.005; 90° FORMED ANGLES ±2° 1°

MATERIAL

FINISH - SEE NOTE

CONTRACT NO

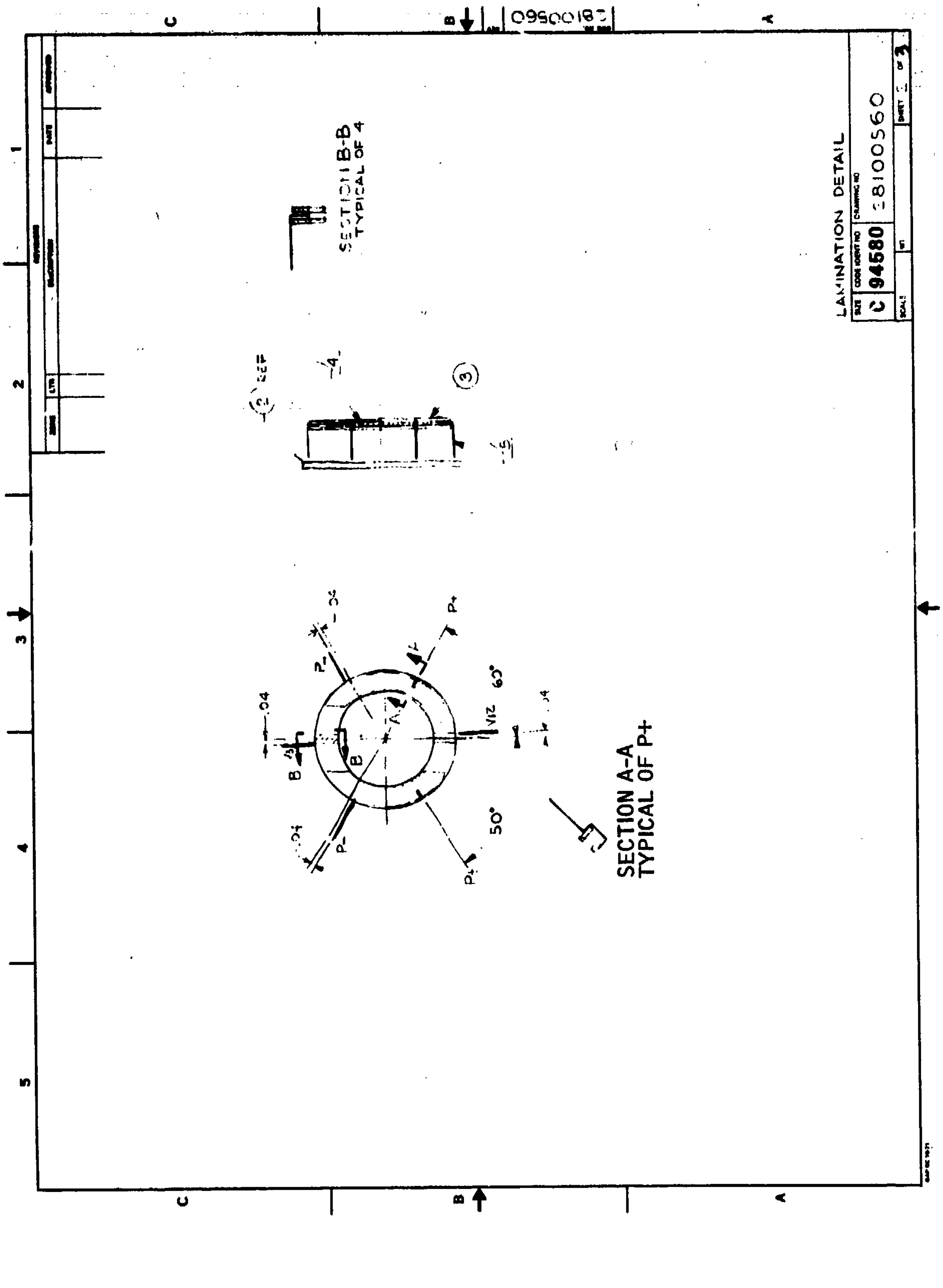
HONEYWELL INC. GOVERNMENT AND AERONAUTICAL PRODUCTS DIVISION, 2600 RIDGWAY PARKWAY, MINNEAPOLIS, MINNESOTA 55413

PIEZOELECTRIC TRANSFORMER (18 MM)

SIZE C | CODE IDENT NO 94580 | DRAWING NO 28100560

SCALE NONE | SHEET 1 OF 3

CONTROL


LAMINATION DETAIL
C 94580 28100560
SECTION B-B
TYPICAL OF 4
SECTION A-A
TYPICAL OF P+
2 REF
3
60°
50°
P+
P-
.04

ELECTRICAL REQUIREMENTS

When a 5 volt (p-p) sine wave input voltage to the PET is applied in parallel to the primary terminals (P_+ and P_-) and the ceramic is driven at its primary resonant frequency with the electrical load on each secondary terminal (V_{12} and V_3) of 10 megohms and 10 pf, the package units shall meet the following electrical requirements.

Resonant Frequency:

22 ± 2°C	33.9 ± 0.2 kHz
52 ± 2°C	34.1 ± 0.2 kHz
-54 ± 2°C	33.3 ± 0.2 kHz

Step-up Voltage Ratio

22 ± 2°C	170 ± 10%
52 ± 2°C	170 ± 10%
-54 ± 2°C	85 ± 10%

Percent Efficiency $\dfrac{V_{12}^{2} + V_3^{2} \times 100}{(V_{in})(I_{in})(10\times10^{6})}$

22 ± 2°C	45% min.
52 ± 2°C	50% min.
-54 ± 2°C	25% min.

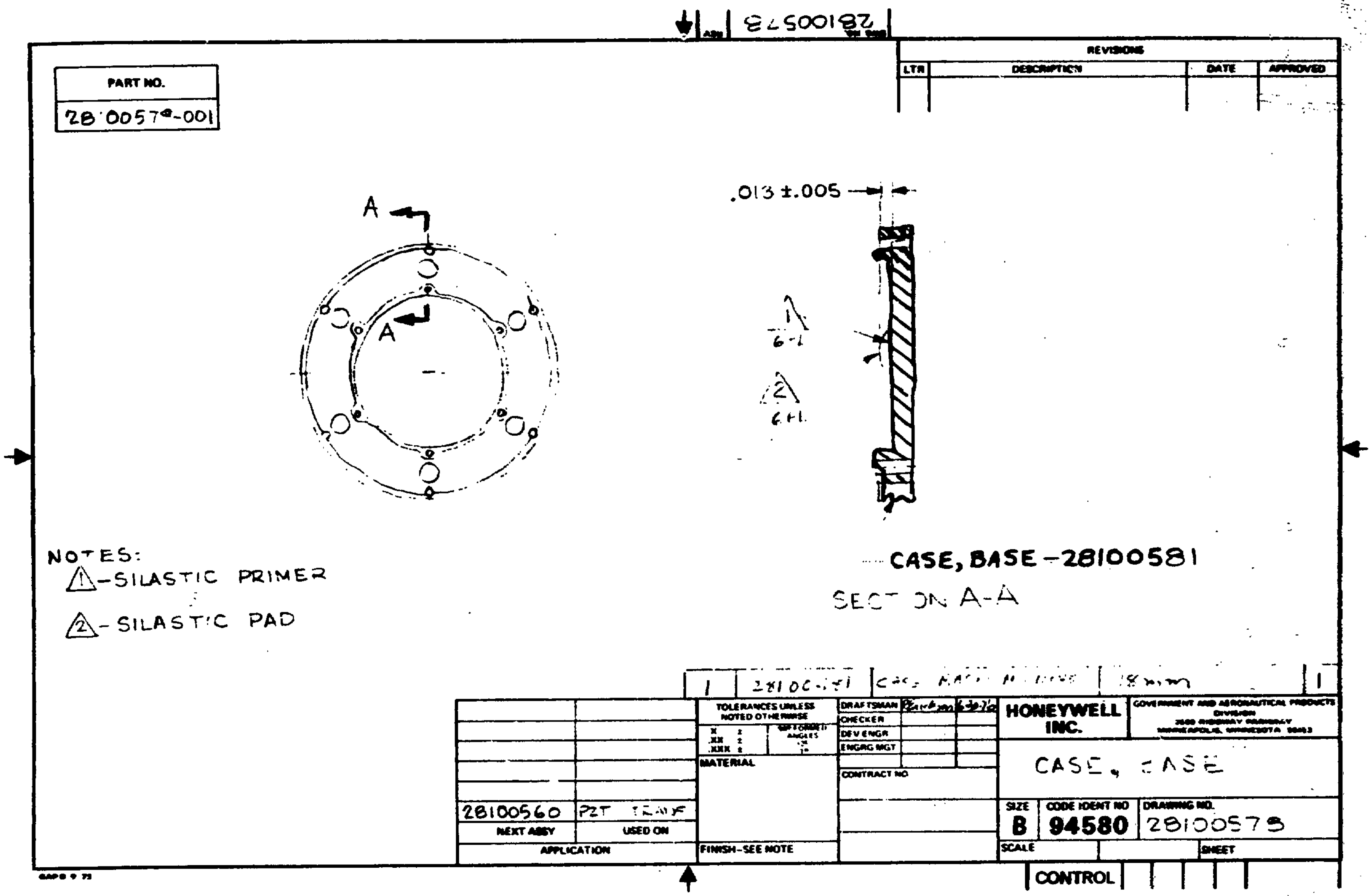
Capacitance and Dissipation Factor: The input and output capacitance shall be measured at a nominal voltage and drive of 1 volt and 1 kHz.

Input Capacitance at Room Temperature		14,000 pf ± 4%
Secondary Capacitance at Room Temperature	V_{12} and V_3	7.6 pf ± 4%
Input Percent Dissipation at Room Temperature		1.75% max.
Secondary Percent Dissipation at Room Temperature	V_{12} and V_3	4.6% max.

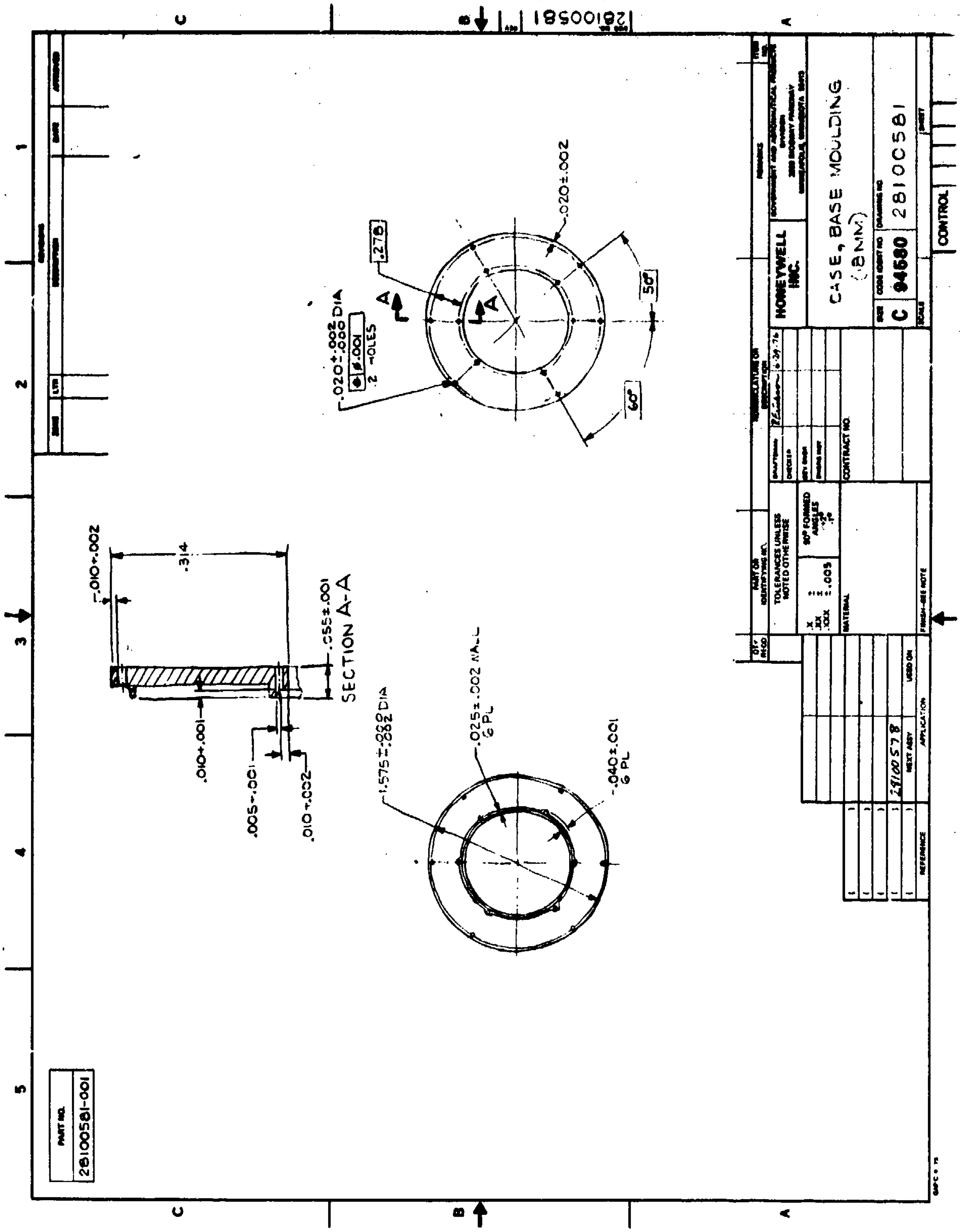
The package PET unit must meet the requirements as described in SCS-480 for solderability, resistance to solder heat, terminal strength, induced voltage, thermal shock, high and low temperature storage, humidity, mechanical shock and vibration, reduced barometric pressure, life and workmanship.

Electrical Requirements

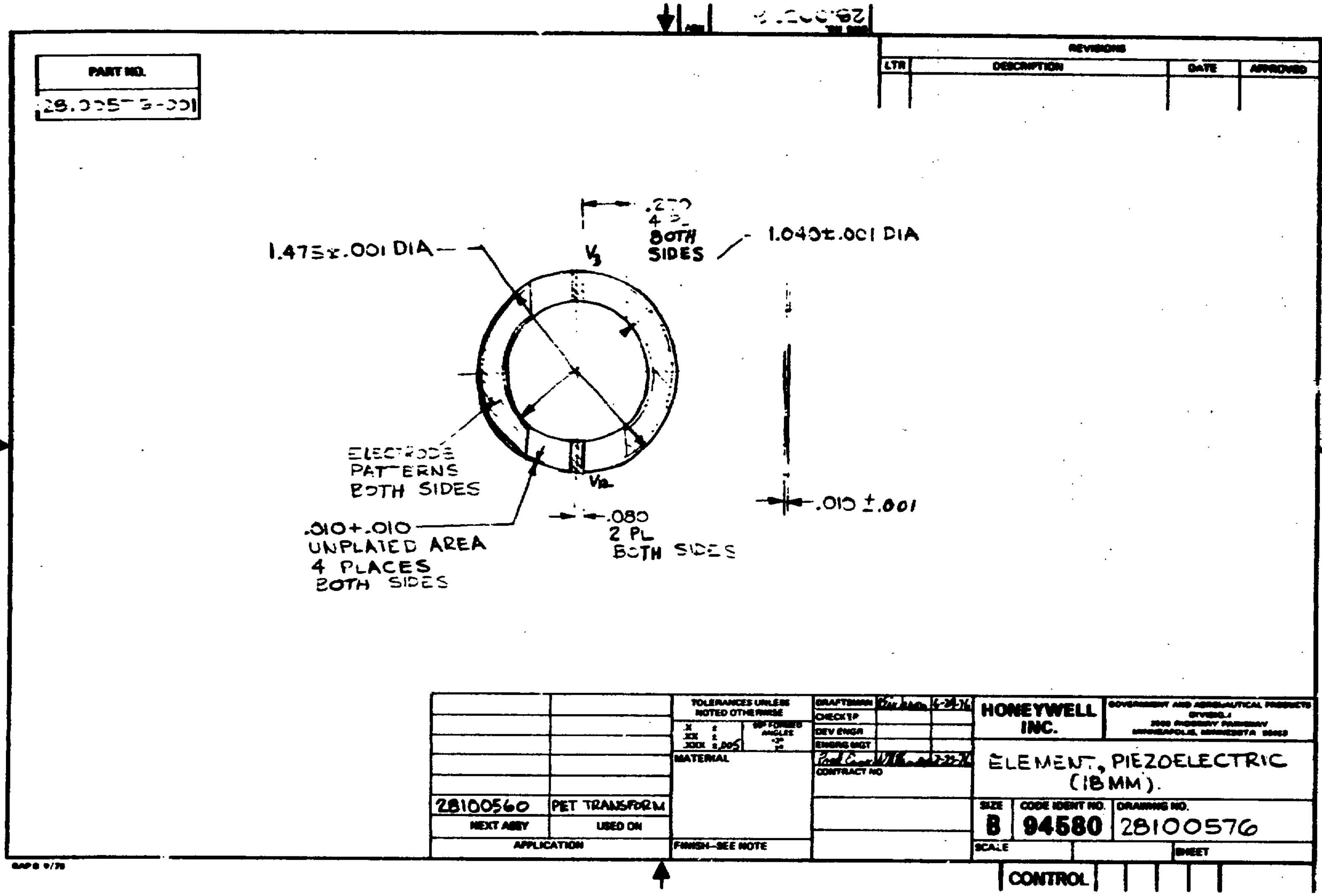
Size	Code Ident No.	Drawing No.
C	94580	28100560
		Sheet 3 of 3

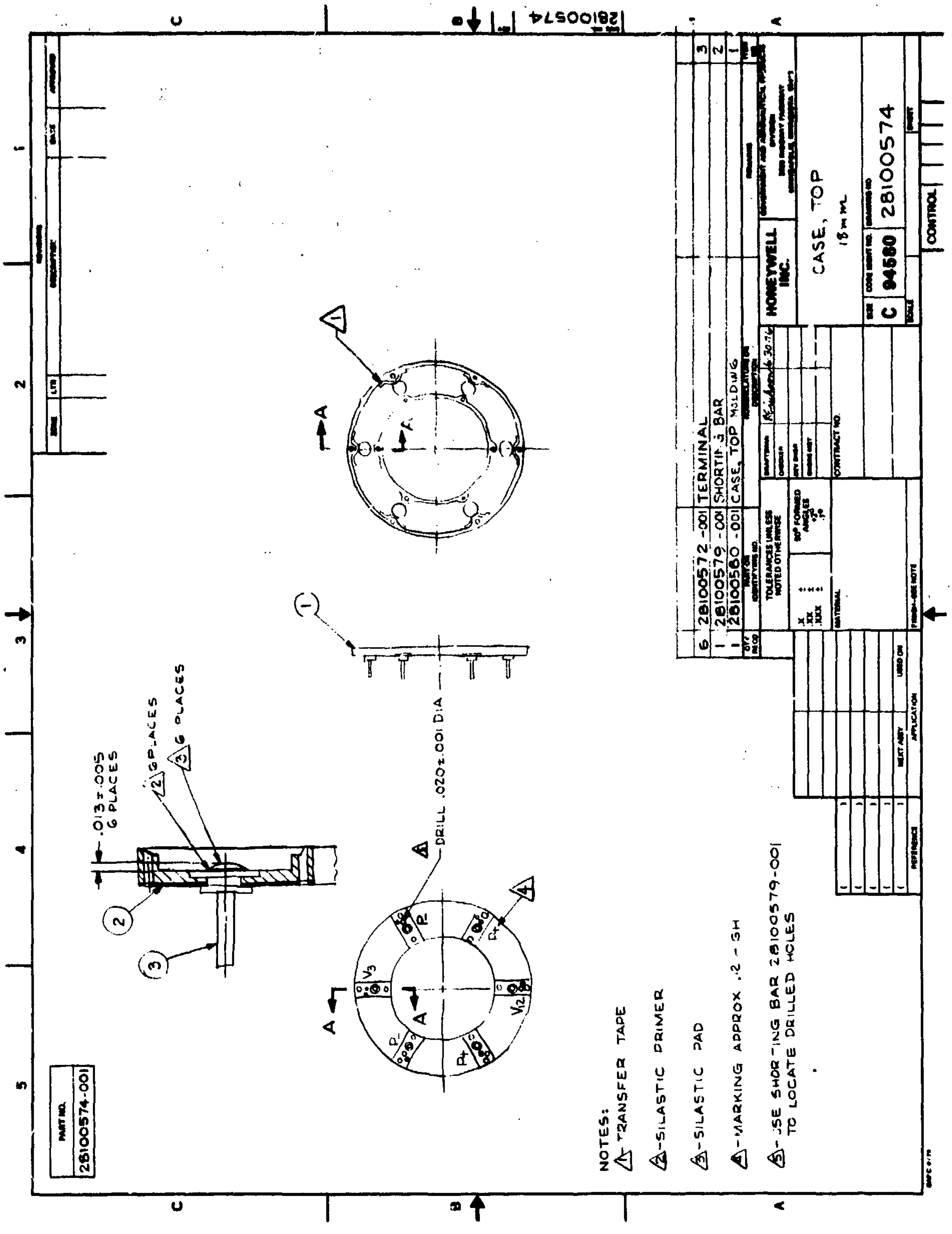


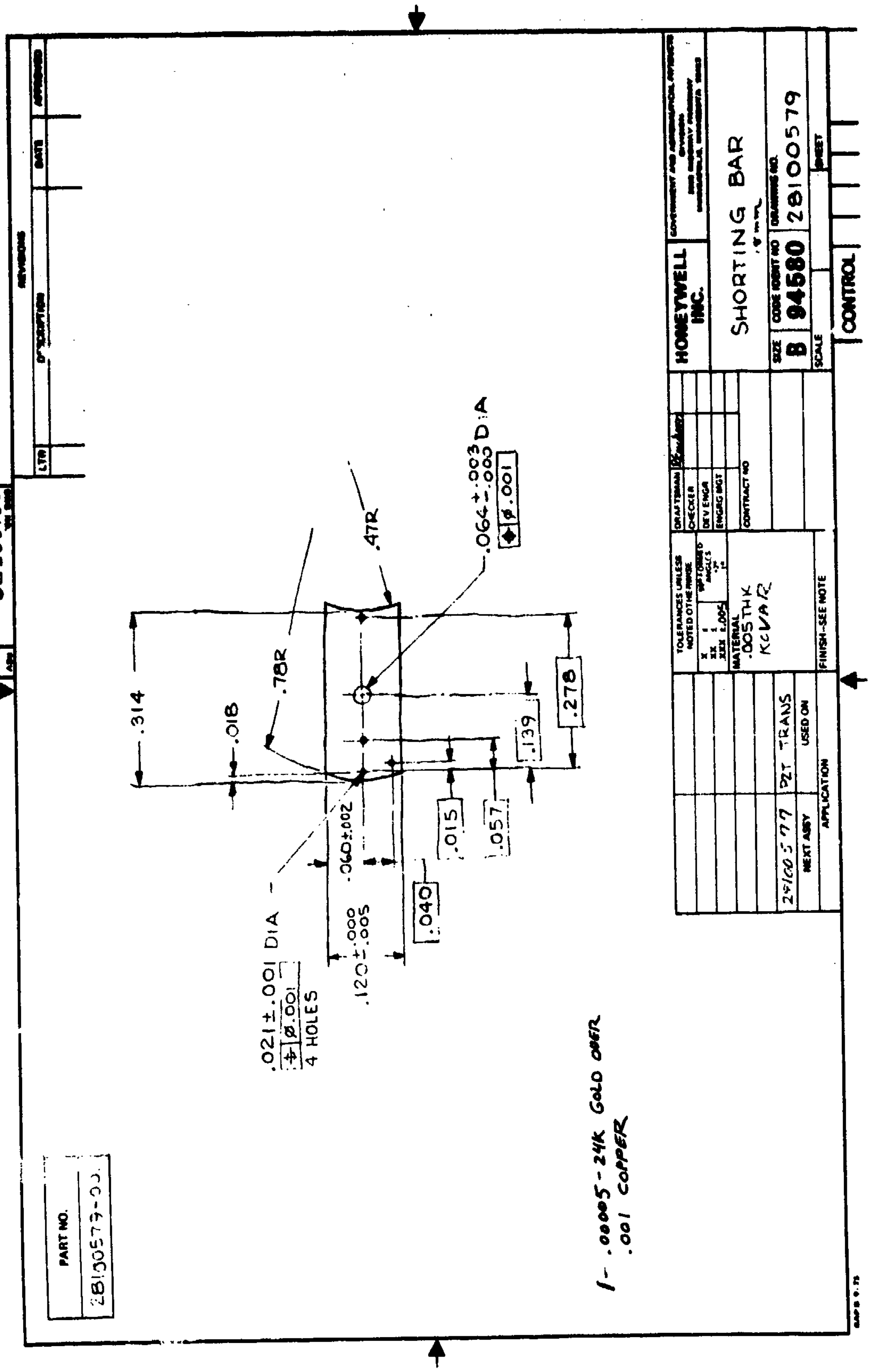
28100578
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
PART NO.
28100578-001
A
A
.013 ±.005
1
2
CASE, BASE -28100581
SECTION A-A
NOTES:
1 - SILASTIC PRIMER
2 - SILASTIC PAD
TOLERANCES UNLESS NOTED OTHERWISE
MATERIAL
FINISH-SEE NOTE
DRAFTSMAN
CHECKER
DEV ENGR
ENGRG MGT
CONTRACT NO
HONEYWELL INC.
GOVERNMENT AND AERONAUTICAL PRODUCTS DIVISION
CASE, CASE
SIZE
B
CODE IDENT NO
94580
DRAWING NO.
28100578
SCALE
SHEET
CONTROL
28100560
PZT
NEXT ASSY
USED ON
APPLICATION



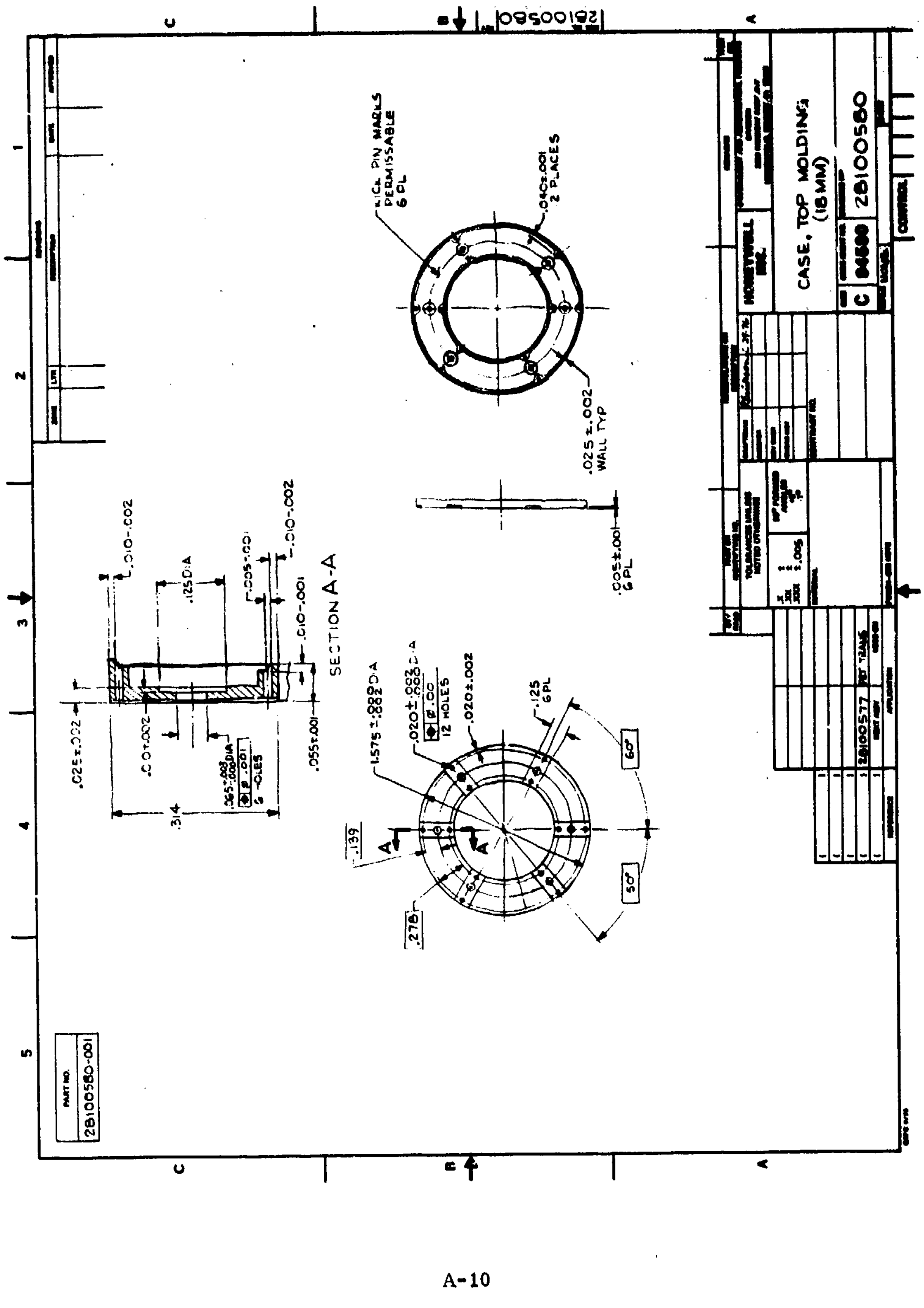
CASE, BASE MOULDING (8MM)
HONEYWELL INC.
C 94580 2810C581
CONTROL
TOLERANCES UNLESS NOTED OTHERWISE
.XXX ±.005
PART NO.
2810581-001
SECTION A-A
.314
.010±.002
.055±.001
.010±.001
.005±.001
.010±.002
1.575 DIA
.025±.002 WALL 6 PL
.040±.001 6 PL
.020±.002 DIA
.020±.002
.278
50°
60°
2810578


PART NO.
28100576-001
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
1.475±.001 DIA
.270
4 PL
BOTH
SIDES
1.040±.001 DIA
V3
V12
ELECTRODE
PATTERNS
BOTH SIDES
.010+.010
UNPLATED AREA
4 PLACES
BOTH SIDES
.080
2 PL
BOTH SIDES
.010 ±.001
TOLERANCES UNLESS NOTED OTHERWISE
.XXX ±.005
MATERIAL
FINISH—SEE NOTE
28100560
PIET TRANSFORM
NEXT ASSY
USED ON
APPLICATION
DRAFTSMAN
CHECK'D
DEV ENGR
ENGRG MGT
CONTRACT NO
HONEYWELL INC.
GOVERNMENT AND AERONAUTICAL PRODUCTS DIVISION
ELEMENT, PIEZOELECTRIC (18 MM).
SIZE
B
CODE IDENT NO.
94580
DRAWING NO.
28100576
SCALE
SHEET
CONTROL

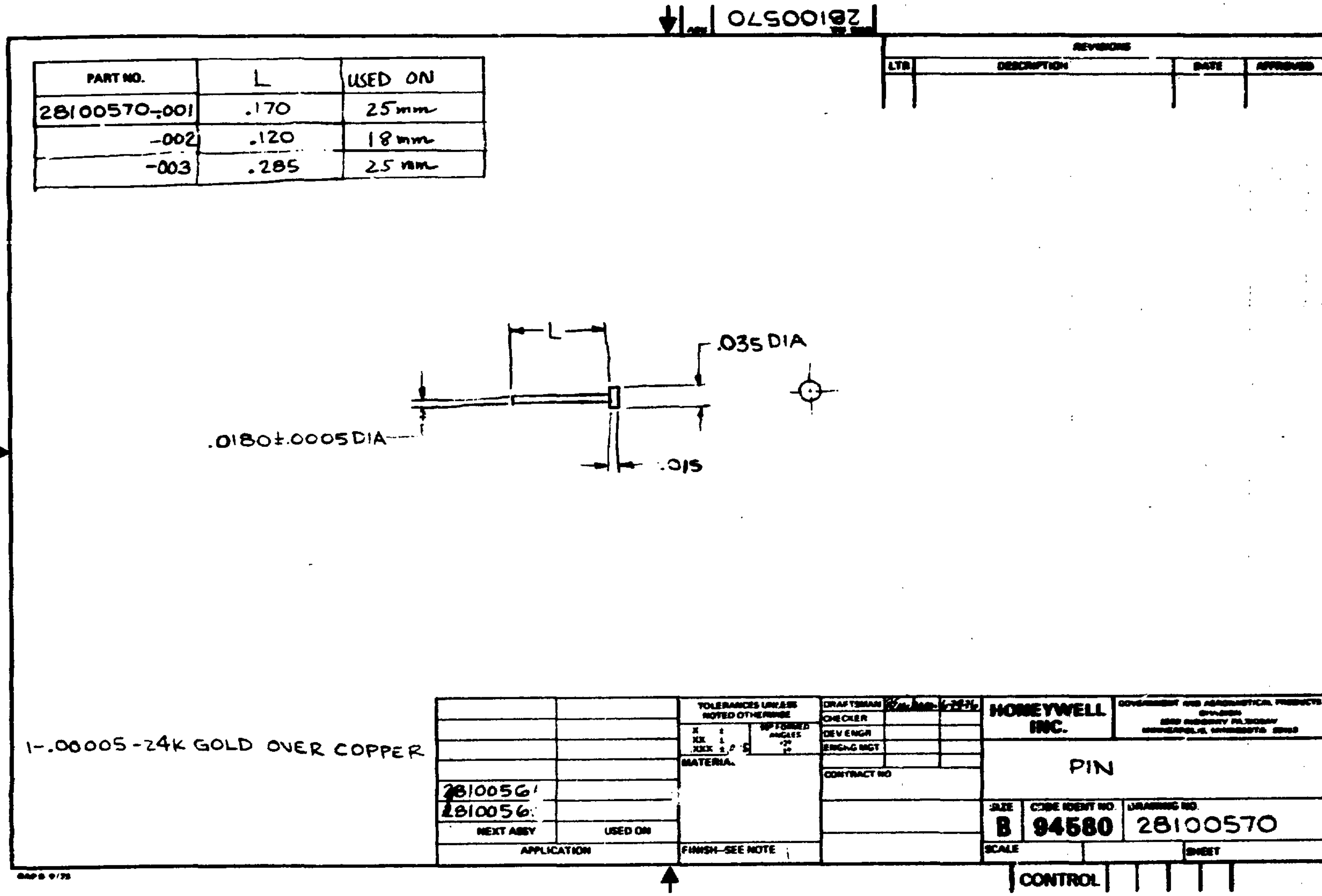

NOTES:
1-TRANSFER TAPE
2-SILASTIC PRIMER
3-SILASTIC PAD
5-USE SHORTING BAR 28100579-001 TO LOCATE DRILLED HOLES
DRILL .020±.001 DIA
.013±.005 6 PLACES
6 PLACES
6 PLACES
6 28100572-001 TERMINAL
1 28100579-001 SHORTING BAR
1 28100580-001 CASE, TOP MOLDING
HONEYWELL INC.
CASE, TOP
C 94580 28100574
PART NO. 28100574-001
CONTROL

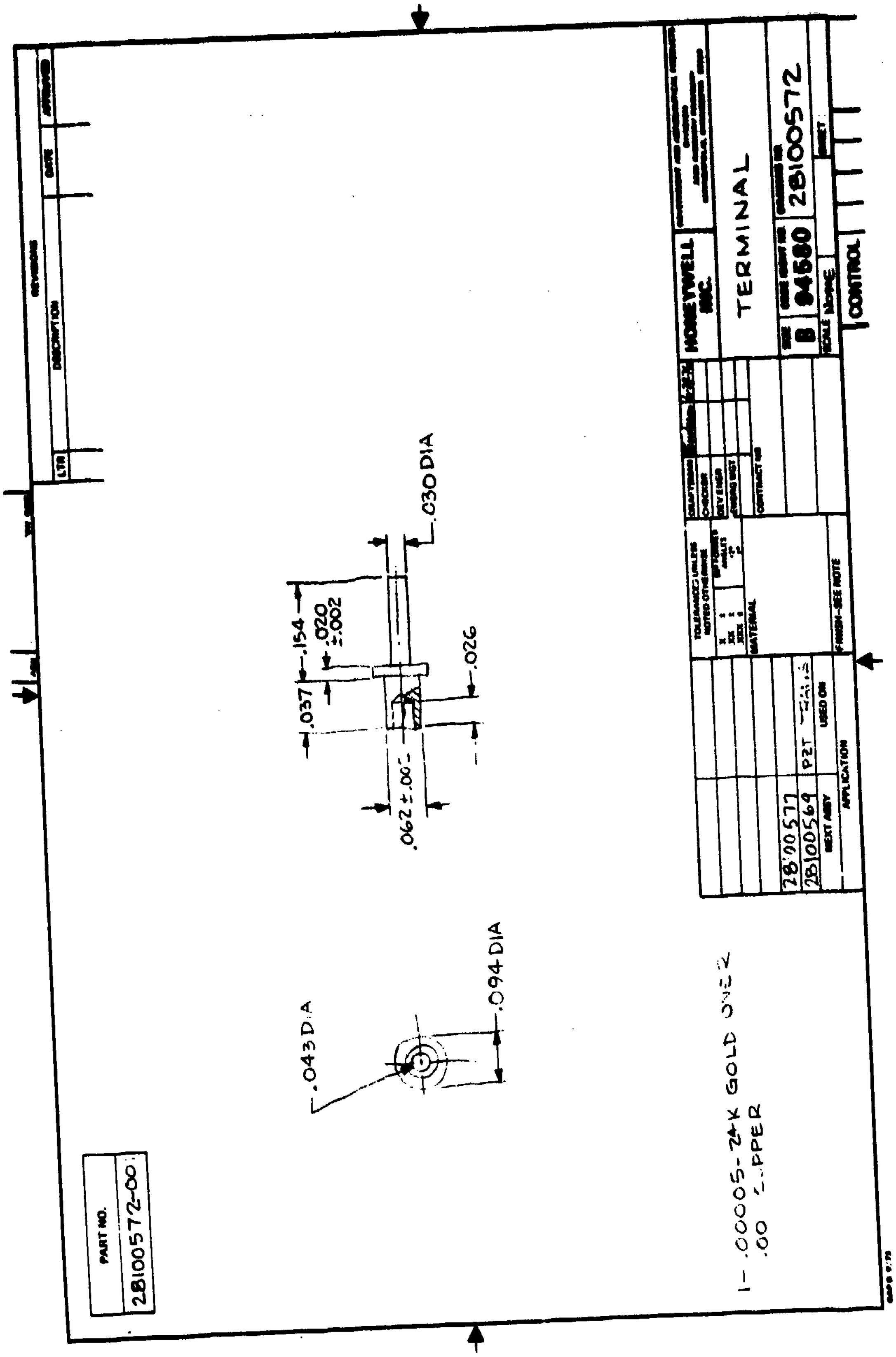


HONEYWELL INC.
SHORTING BAR
SIZE B
CODE IDENT NO 94580
DRAWING NO. 28100579
SCALE
SHEET
CONTROL
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
28100579
DRAFTSMAN
CHECKER
DEV ENGR
ENGRG MGT
CONTRACT NO
TOLERANCES UNLESS NOTED OTHERWISE
MATERIAL .005 THK KOVAR
FINISH-SEE NOTE
28100577
PZT TRANS
NEXT ASSY
USED ON
APPLICATION
PART NO.
28100579-01
.314
.018
.78R
.47R
.064 +.003 -.000 DIA
ø.001
.278
.139
.015
.057
.040
.060±.002
.120 +.000 -.005
.021 ± .001 DIA
ø.001
4 HOLES
1- .00005 - 24K GOLD OVER .001 COPPER



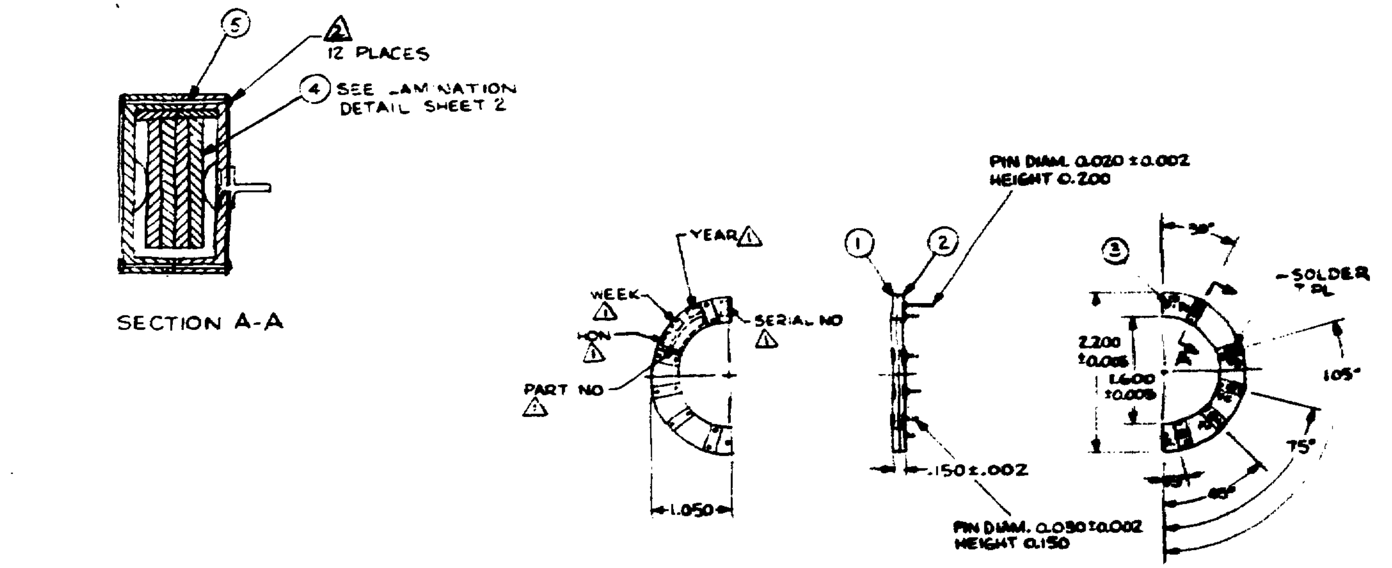
CASE, TOP MOLDING (16MM)
HONEYWELL INC.
C
28100580
PART NO.
28100580-001
SECTION A-A
KICK PIN MARKS PERMISSABLE 6 PL
.040±.001 2 PLACES
.025±.002 WALL TYP
.005±.001 6 PL
.125 DIA
.314
.020±.002
12 HOLES
1.575 DIA
.125 6 PL
60°
50°
.139
.278
28100577
NEXT ASSY


28100570
PART NO. | L | USED ON
28100570-001 | .170 | 25mm
-002 | .120 | 18mm
-003 | .285 | 25mm
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
L
.035 DIA
.0180±.0005 DIA
.015
1-.00005-24K GOLD OVER COPPER
28100561
2810056
NEXT ASSY
USED ON
APPLICATION
TOLERANCES UNLESS NOTED OTHERWISE
MATERIAL
FINISH—SEE NOTE
DRAFTSMAN
CHECKER
DEV ENGR
CONTRACT NO
HONEYWELL INC.
PIN
SIZE
B
CODE IDENT NO
94580
DRAWING NO
28100570
SCALE
SHEET
CONTROL



REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
.030 DIA
.154
.020
±.002
.026
.037
.094 DIA
.043 DIA
PART NO.
28100572-00
TOLERANCES UNLESS NOTED OTHERWISE
MATERIAL
FINISH-SEE NOTE
CONTRACT NO
28100577
28100569
P2T
NEXT ASSY
USED ON
APPLICATION
HONEYWELL INC.
TERMINAL
B
94580
28100572
SCALE NONE
CONTROL

PART NO. 28100561-001



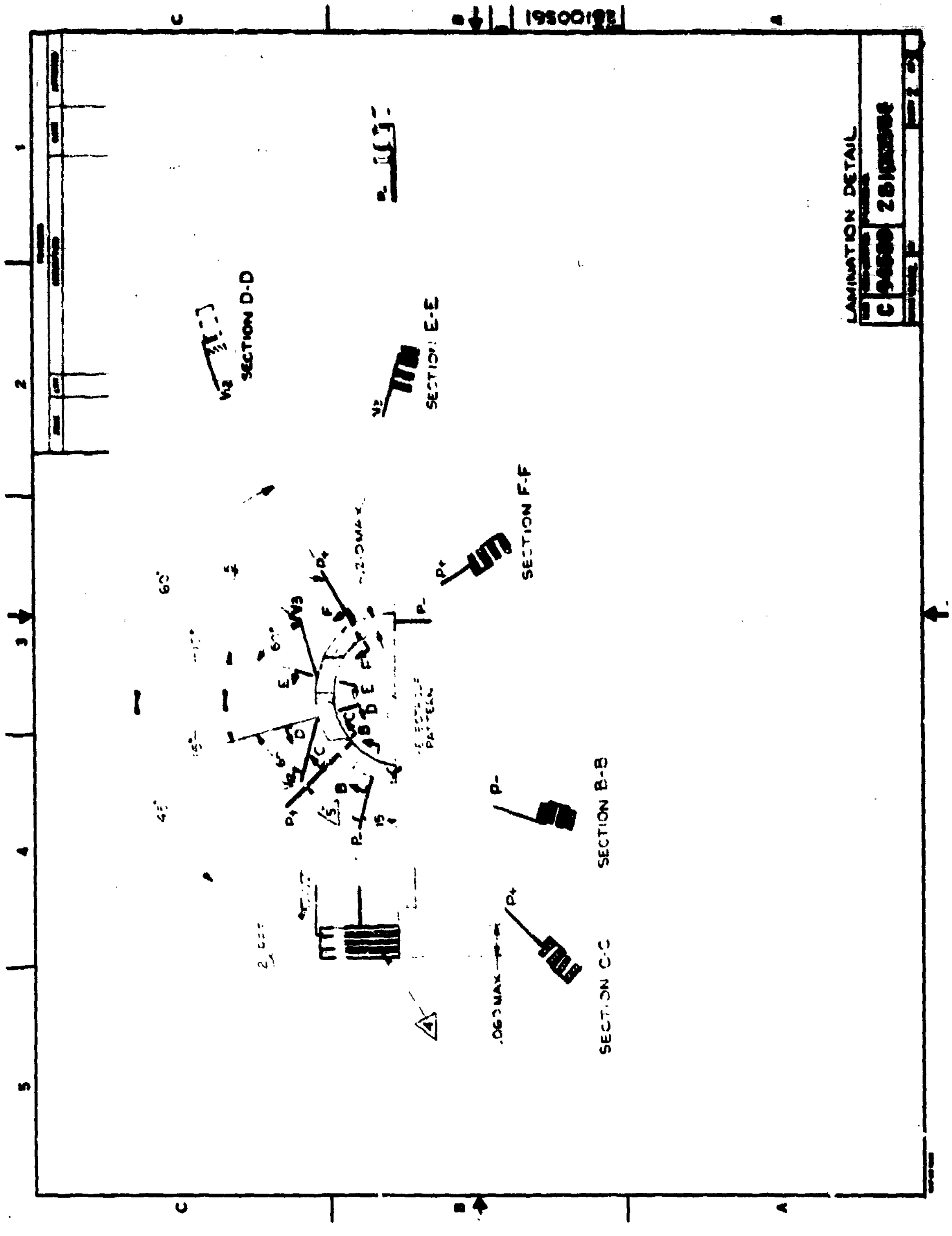
NOTES:
1. MARK .06 HIGH UNLESS OTHERWISE SPECIFIED
2. SOLDER.
3. ELECTRICAL TESTS:- SEE SHEET 3
4. BOND WITH EPOXY .003 TO .004 THICK
5. GOLD LEAD WIRE .005 BY .010

12	28100570-001	PIN		5
4	28100571-001	ELEMENT	SEE SHEET 2	4
1	28100570-003	PIN	(P-)	3
1	28100577-001	CASE, TOP		2
1	28100578-001	CASE, BASE		1

HONEYWELL INC.

PIEZOELECTRIC TRANSFORMER (25MM)

C 28100561


LAMINATION DETAIL
SECTION D-D
SECTION E-E
SECTION F-F
SECTION B-B
SECTION C-C
.060 MAX

ELECTRICAL REQUIREMENTS

When a 5 volt (p-p) sine wave input voltage to the PET is applied in parallel to the primary terminals (P_+ and P_-), and the ceramic is driven at its primary resonant frequency with an electrical load on each secondary terminal (V_{12} and V_3) of 10 megohms and 10 pf, the packaged units shall meet the following electrical requirements.

Resonant Frequency:

22 ± 2°C	33.9 ± 0.2 kHz
52 ± 2°C	34.1 ± 0.2 kHz
-54 ± 2°C	33.3 ± 0.2 kHz

Step-up Voltage Ratio V_{12} or V_3 output/input voltage

22 ± 2°C	170 ± 10%
52 ± 2°C	170 ± 10%
-54 ± 2°C	85 ± 10%

Percent Efficiency $$\frac{V_{12}^2 + V_3^2 \times 100}{(V_{in.})(I_{in.})(10 \times 10^6)}$$

22 ± 2°C	45 min.
52 ± 2°C	50 min.
-54 ± 2°C	25 min.

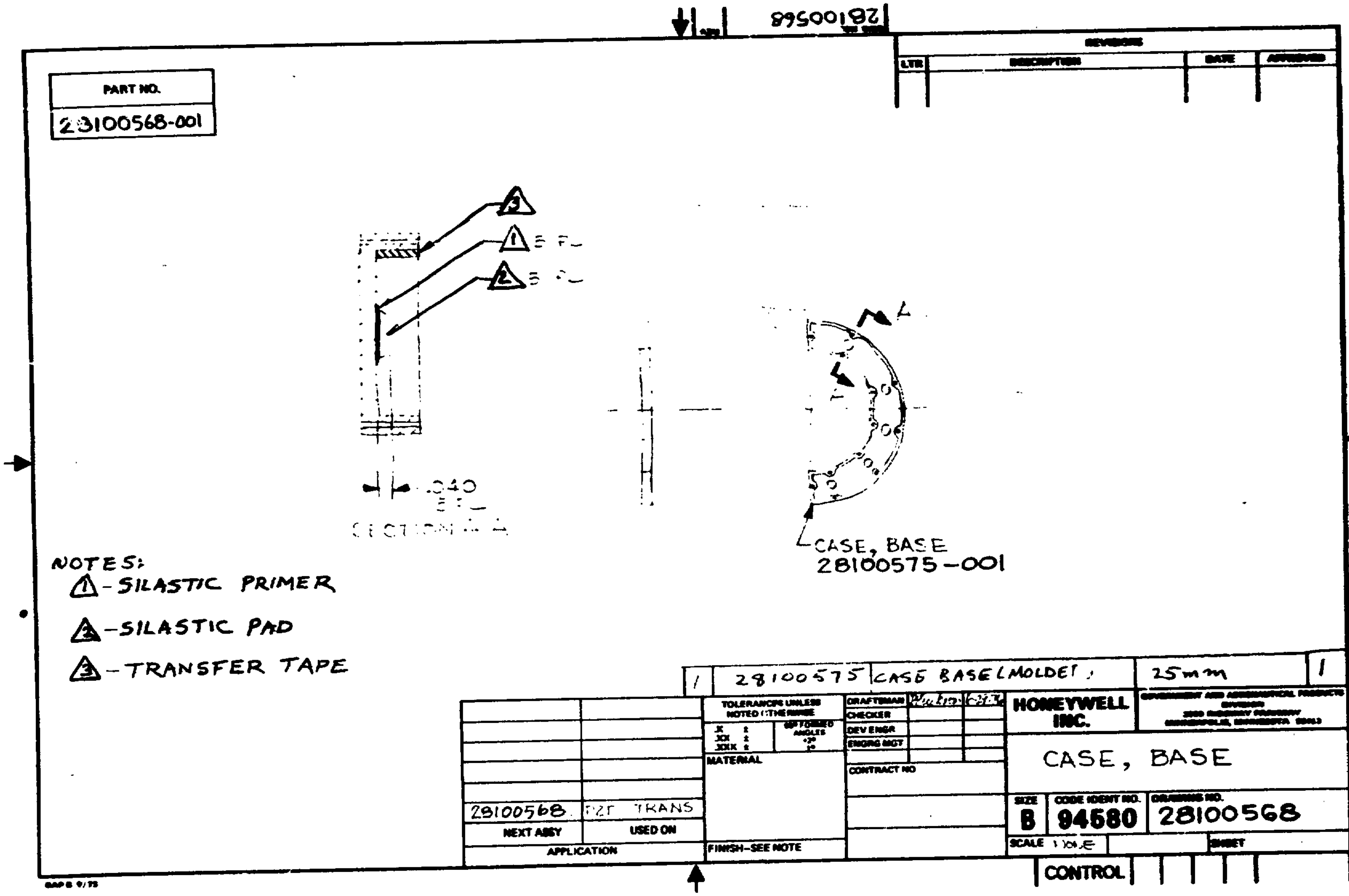
Capacitance and Dissipation Factor: The input and output capacitance shall be measured at a nominal voltage and drive of 1 volt and 1 kHz.

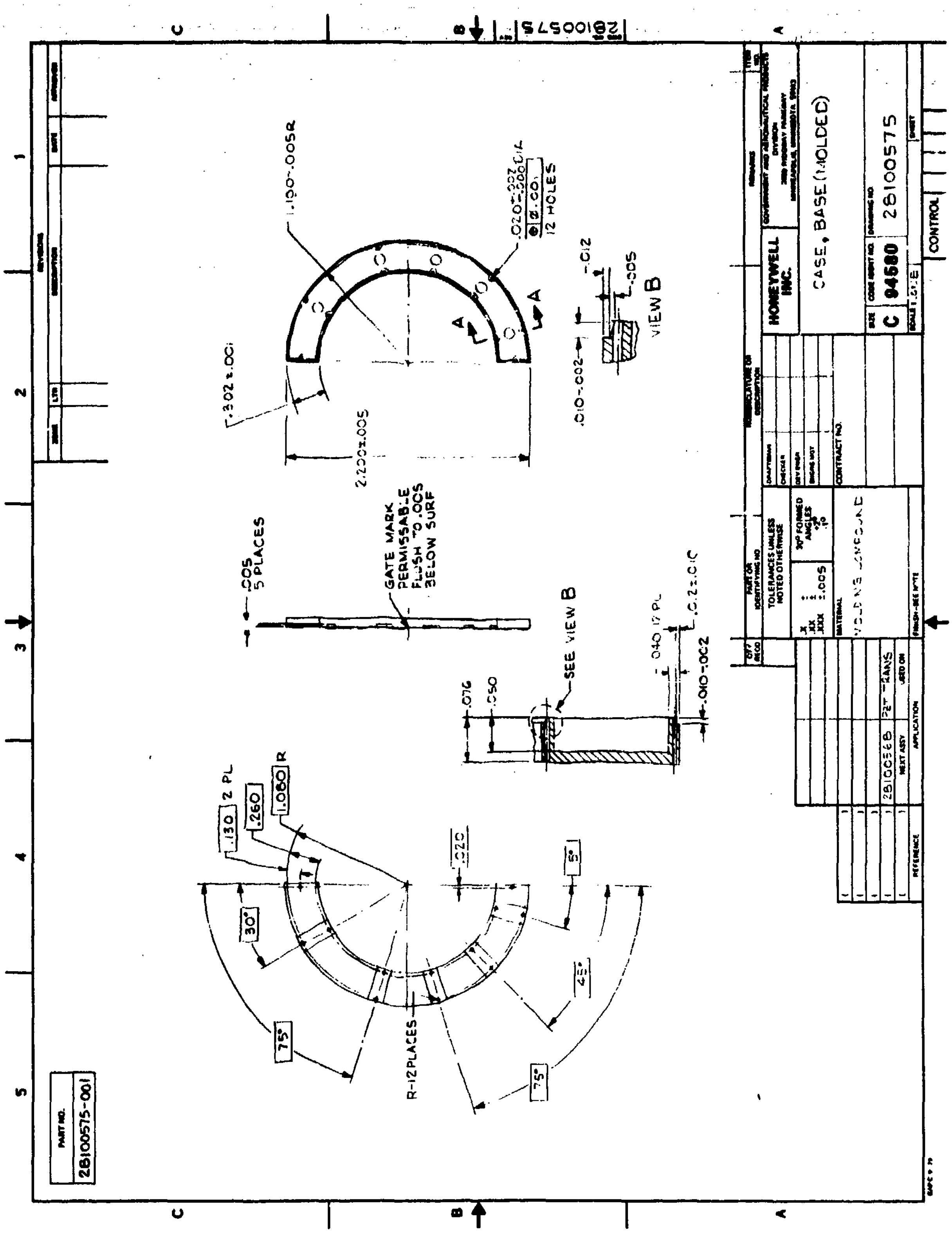
Input Capacitance at Room Temperature		14,000 pf ± 4%
Secondary Capacitance at Room Temperature	V_{12} and V_3	7.6 pf ± 4%
Input Percent Dissipation at Room Temperature		1.75% max.
Secondary Percent Dissipation at Room Temperature	V_{12} and V_3	4.6% max.

The package PET unit must meet the requirements as described in SCS-480 for solderability, resistance to solder heat, terminal strength, induced voltage, thermal shock, high and low temperature storage, humidity, mechanical shock and vibration, reduced barometric pressure, life and workmanship.

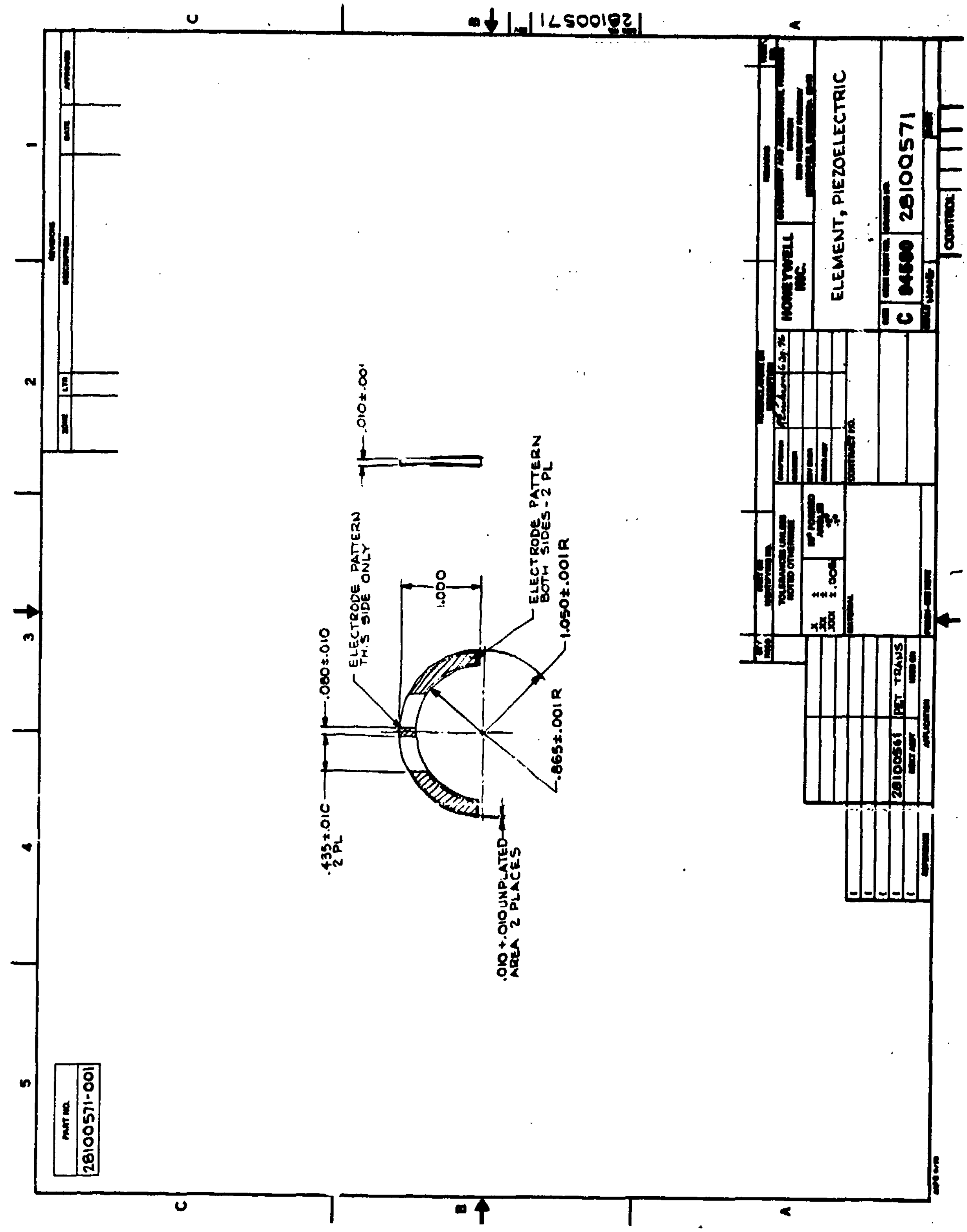
Electrical Requirements

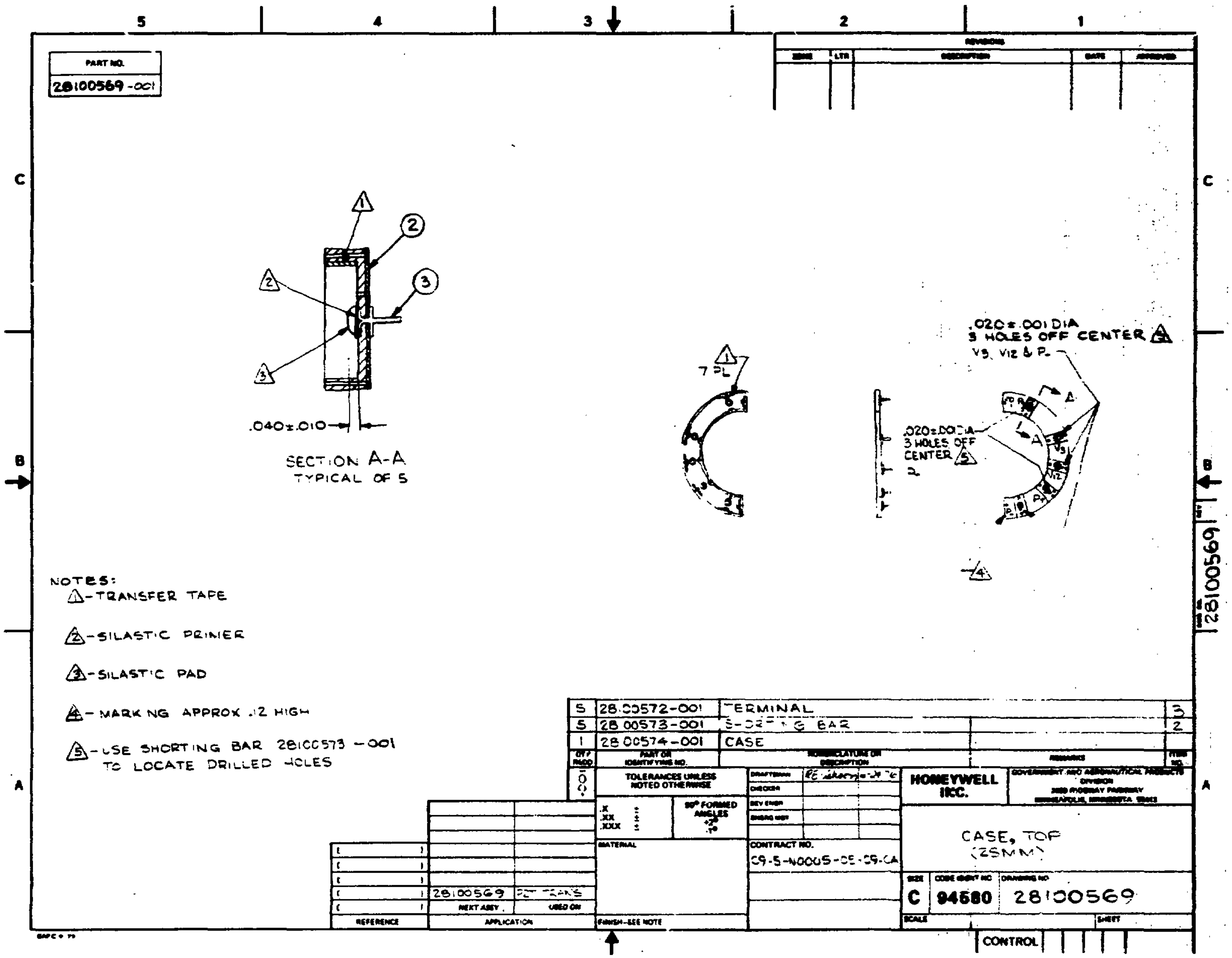
Size	Code Ident No.	Drawing No.
C	94580	28100561
		Sheet 3 of 3


PART NO.
23100568-001
.040
CASE, BASE
28100575-001
NOTES:
1 - SILASTIC PRIMER
2 - SILASTIC PAD
3 - TRANSFER TAPE
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
28100568
1
28100575
CASE BASE (MOLDED)
25mm
1
TOLERANCES UNLESS NOTED OTHERWISE
MATERIAL
FINISH—SEE NOTE
DRAFTSMAN
CHECKER
DEV ENGR
ENGRG MGT
CONTRACT NO
HONEYWELL INC.
CASE, BASE
SIZE
B
CODE IDENT NO.
94580
DRAWING NO.
28100568
SCALE
NONE
SHEET
CONTROL
28100568
TRANS
NEXT ASSY
USED ON
APPLICATION

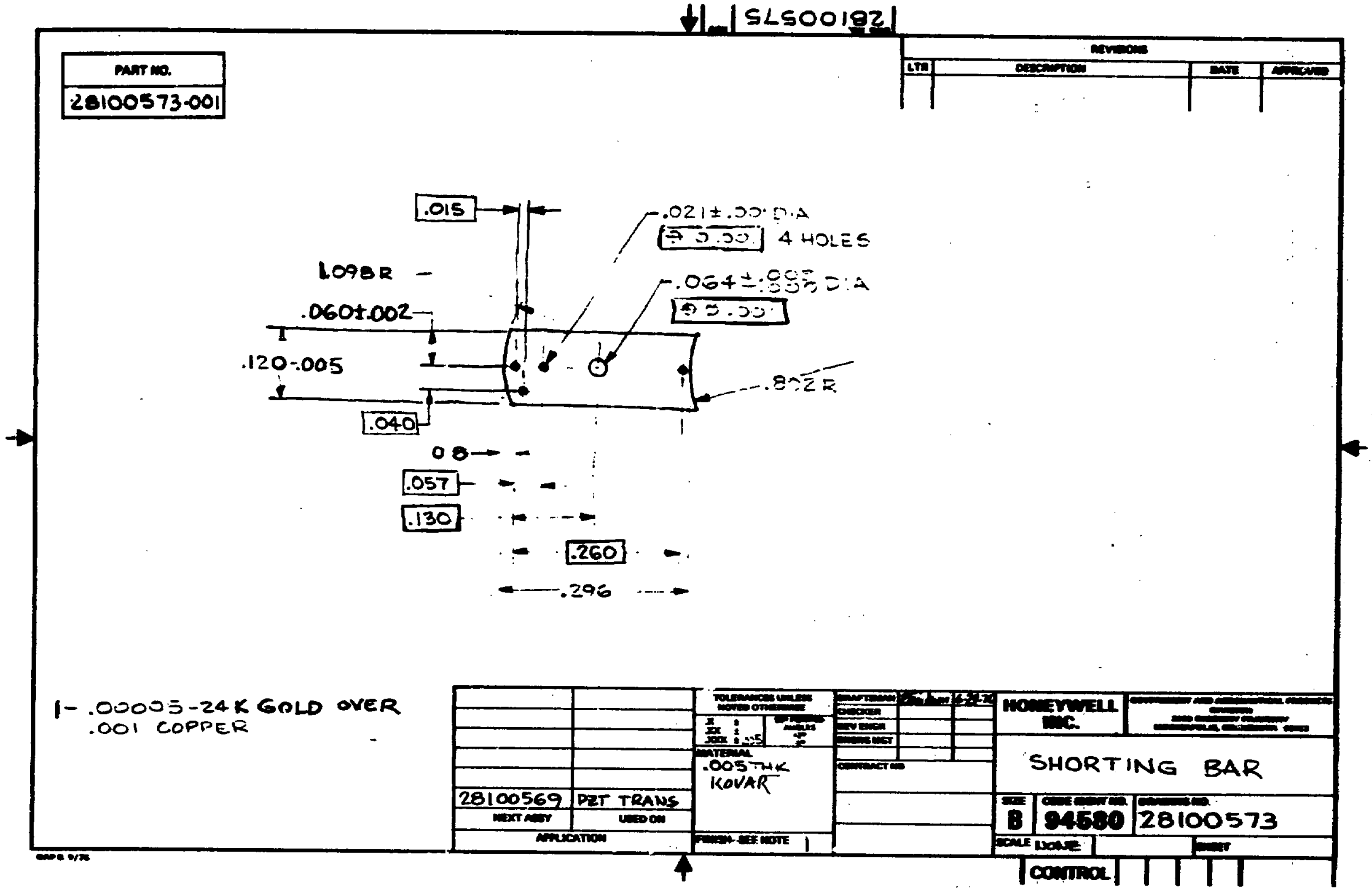


HONEYWELL INC.
CASE, BASE (MOLDED)
C 94580 28100575
CONTROL
PART NO.
28100575-001
TOLERANCES UNLESS NOTED OTHERWISE
1.100-.005R
.302±.001
2.200±.005
12 HOLES
VIEW B
SEE VIEW B
.005 5 PLACES
GATE MARK PERMISSABLE FLUSH TO .005 BELOW SURF
.130 2 PL
.260
1.060 R
30°
75°
45°
5°
R-12PLACES

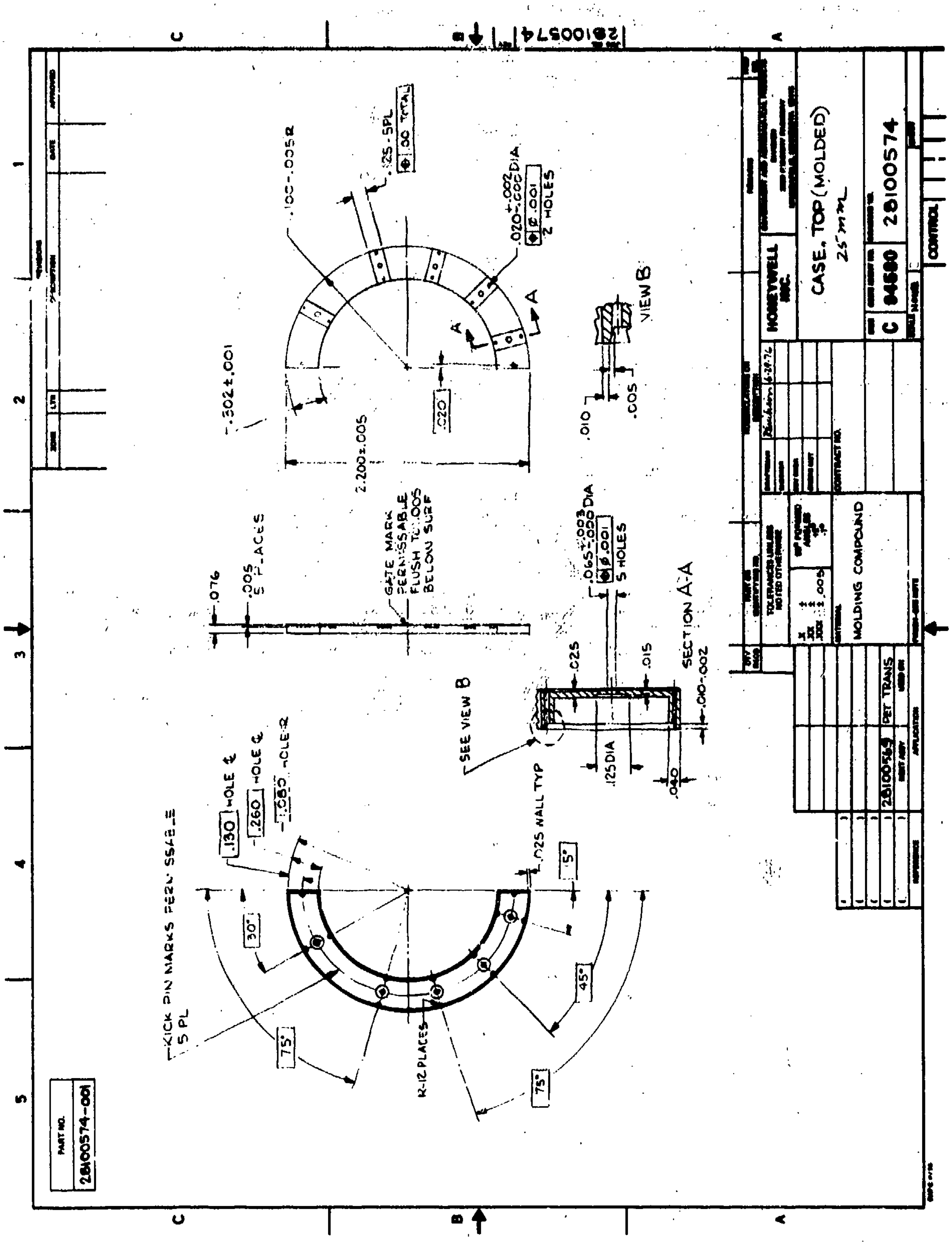

ELEMENT, PIEZOELECTRIC
HONEYWELL INC.
C 94580 28100571
CONTROL
28100571
PART NO.
28100571-001
.010±.001
ELECTRODE PATTERN THIS SIDE ONLY
1.000
ELECTRODE PATTERN BOTH SIDES - 2 PL
1.050±.001R
.865±.001R
.080±.010
.435±.010 2 PL
.010+.010 UNPLATED AREA 2 PLACES
28100561 DET TRANS



PART NO.
28100569-001
.040±.010
SECTION A-A
TYPICAL OF 5
7 PL
.020±.001 DIA
3 HOLES OFF CENTER
V9, V12 & P
.020±.001 DIA
3 HOLES OFF CENTER
NOTES:
1 - TRANSFER TAPE
2 - SILASTIC PRIMER
3 - SILASTIC PAD
4 - MARKING APPROX .12 HIGH
5 - USE SHORTING BAR 28100573-001 TO LOCATE DRILLED HOLES
5 28100572-001 TERMINAL 3
5 28100573-001 SHORTING BAR 2
1 28100574-001 CASE
QTY REQD
PART OR IDENTIFYING NO.
NOMENCLATURE OR DESCRIPTION
REMARKS
ITEM NO.
TOLERANCES UNLESS NOTED OTHERWISE
.X
.XX
.XXX
90° FORMED ANGLES
MATERIAL
FINISH-SEE NOTE
DRAFTSMAN
CHECKER
CONTRACT NO.
C9-5-N0005-05-C9-CA
HONEYWELL INC.
CASE, TOP
(25MM)
SIZE
C
CODE IDENT NO
94580
DRAWING NO
28100569
SCALE
SHEET
CONTROL
28100569
NEXT ASSY
USED ON
APPLICATION
REFERENCE
REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED



28100575
PART NO.
28100573-001
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
.015
.021±.00 DIA
4 HOLES
L09BR
.064±.003 DIA
.060±.002
.120-.005
.040
.802 R
08
.057
.130
.260
.296
1- .00005-24K GOLD OVER
.001 COPPER
28100569
PZT TRANS
NEXT ASSY
USED ON
APPLICATION
TOLERANCES UNLESS NOTED OTHERWISE
MATERIAL
.005 THK
KOVAR
FINISH- SEE NOTE 1
DRAFTSMAN
CHECKER
CONTRACT NO
HONEYWELL INC.
SHORTING BAR
SIZE
B
94580
28100573
SCALE
NONE
SHEET
CONTROL


HONEYWELL INC.
CASE, TOP (MOLDED)
25 mm
C 94580 28100574
CONTROL
MOLDING COMPOUND
28100569 PET TRANS
PART NO. 28100574-001
SECTION A-A
VIEW B
SEE VIEW B
KICK PIN MARKS PERMISSABLE 5 PL
GATE MARK PERMISSABLE FLUSH TO .005 BELOW SURF
.025 WALL TYP
R-.12 PLACES
5 HOLES
2 HOLES
2.200±.005
.302±.001

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